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Document Processing Center EPA East – Room 6428 Attn: Section 8(e) Office of Pollution Prevention and Toxics, U.S. EPA 1200 Pennsylvania Avenue NW Washington, DC 20460-0001

Re:

TSCA 8(e) Substantial Risk Notice: Sulfonate-based and Carboxylic-based Fluorochemicals, Docket 8EHQ-0598-373 - Results from 2011 Analyses of Fish and Surface Water from the Mississippi River

Dear Sir or Madam:

3M is submitting this notice to supplement previous submissions on sulfonyl and carboxylic-based fluorochemicals (FCs), and more specifically our June 20, 2006, November 9, 2009 and February 11, 2010 submittals concerning fish studies conducted by the Minnesota Pollution Control Agency (MPCA) and our own study that was the subject of correspondence dated December 23, 2011.

The aforementioned December 23, 2011 submittal documented an extensive study of Pool 2 of the Mississippi River that was commissioned by 3M to evaluate the summer 2011 levels of FCs in fish tissue and surface water. At that time, the analytical work for perfluorooctane sulfonate (PFOS) for the study had been completed and was documented in a report entitled Mississippi River Pool 2 PFOS Assessment – Fish Tissues and Surface Water – Summer 2011. This report, along with three supporting analytical reports, was submitted to the subject docket in December 2011.

Subsequently, final analytical results have been generated for the twelve additional FC analytes that were also part of the 2011 Mississippi River Pool 2 study. These include perfluorobutane sulfonate, perfluorohexane sulfonate, perfluorooctane sulfonamide, perfluorobutyric acid, perfluoropentanoic acid, perfluorohexanoic acid, perfluorohexanoic acid, perfluorooctanoic acid, perfluorodecanoic acid, perfluorooctanoic acid and perfluorododecanoic acid. Results for these constituents, along with the previously submitted perfluorooctane sulfonate data, for both fish tissue and surface water, have recently been compiled in a comprehensive report entitled Mississippi River Pool 2 PFC Assessment – Fish Tissues and Water – Summer 2011 (enclosed).

CONTAINS NO CBI

While 3M does not believe that any of these data taken alone or cumulatively meet the "substantial risk" reporting threshold, we nevertheless recognize the ongoing work by U.S. EPA to assess fluorochemical exposure pathways. Therefore, we are placing these results in the 8(e) docket as a supplement to previous submissions.

If you have any questions, please contact Deanna Luebker at 651-737-1374 or djluebker@mmm.com .

Sincerely,

Jean B. Sweeney

Vice President

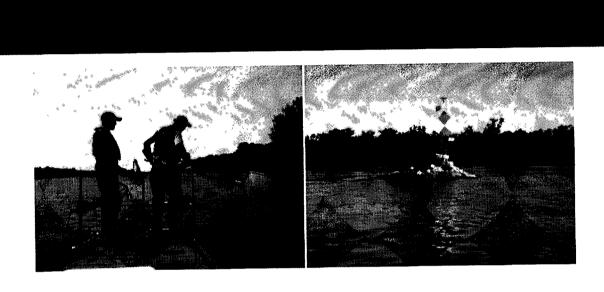
Environmental, Health and Safety Operations

Jan B. Sweney (A)

Enclosure



Shaping the Future



Mississippi River Pool 2 PFC Assessment – Fish Tissues and Water – Summer 2011

November 2012

Project No. 70784004

Prepared For 3M Company

Mississippi River Pool 2 PFC Assessment – Fish Tissues and Water – Summer 2011

November 2012

Project No. 70784004



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List of Acronyms

ASTM International; formerly known as American Society for Testing and

Materials

CCV Continuing Calibration Verification

CoC Chain of Custody

DI Deionized (water)

ECF Electrochemical fluorination

GPS Global Positioning System

HPLC/MS/MS High Performance Liquid Chromatography/Tandem Mass Spectrometry

IQR Interquartile Range

LC-MS/MS Liquid Chromatography/Mass Spectrometry or Triple Quadrapole Mass

Spectrometry

LCS Laboratory Control Spike

LIMS Laboratory Information Management System

LLOQ Lower Limit of Quantitation

LMS Laboratory Matrix Spike

LOQ Limit of Quantitation

MDH Minnesota Department of Health

MDNR Minnesota Department of Natural Resources

MPCA Minnesota Pollution Control Agency

MRM Multiple Reaction Monitoring

MSU Michigan State University

OPR Ongoing Precision and Recovery

PFC Perfluorochemical

PFAS Perfluoroalkyl Sulfonate

PFCA Perfluorocarboxylic Acid

PFOS Perfluorooctane sulfonate

QAPP Quality Assurance Project Plan

QA/QC Quality Assurance/Quality Control

RPD Relative Percent Difference

RSD Relative Standard Deviation

SOP Standard Operating Procedure

SPE Solid Phase Extraction

TMDL Total Maximum Daily Loading

USEPA United States Environmental Protection Agency

USFWS United States Fish and Wildlife Service

WTL Wildlife Toxicology Laboratory, Michigan State University

WW wet weight

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Executive Summary

The presence of perfluorochemicals (PFCs) in the ambient environment is of interest to numerous stakeholders. In Minnesota, there is a growing dataset of measured levels of PFCs in surface waters and fish tissue. The Mississippi River, and more specifically Pool 2 of the river, is one water body that has experienced such an increase in monitoring data in recent years.

In May 2011, Cardno ENTRIX was contracted by 3M to collect fish and water samples from Pool 2 of the Mississippi River. Cardno ENTRIX and Cardno JFNew personnel made three trips to Pool 2 throughout the summer. The study objective called for the collection of ten samples of each of four fish species (freshwater drum, bluegill, smallmouth bass and white bass) from ten reaches within Pool 2 for a total fish collection target of up to 400 fish. This goal was essentially met with the collection of 396 fish. A contemporaneous collection of 30 water samples, 3 from each of the 10 reaches, was also completed. Blinded fish tissue and water samples were analyzed for 4 perfluoroalkyl sulfonates (PFAS) including perfluorooctane sulfonate (PFOS) and nine other perfluoroalkyl carboxylates (PFCAs) at the 3M Environmental Laboratory (3M lab, ISO17025 Accredited) and at the AXYS Analytical Services laboratory (AXYS, ISO17025 Accredited). The 3M lab in St. Paul, MN received all fish fillet and water samples while AXYS served as a third-party confirmation laboratory and received splits of 68% of the water samples and ~10% of the fish fillet tissue samples generated.

In November 2011, a report titled "Mississippi River Pool 2 PFOS Assessment – Fish Tissues and Water – Summer 2011" was prepared by Cardno ENTRIX. At that time, the analytical results for PFOS had been finalized. Subsequently, final analytical results for additional analytes have been completed. This report has been written to present all of the results, including those previously reported for PFOS, in one comprehensive document.

While the focus of this study was on PFOS, this report presents analytical results for PFOS and twelve other PFCs that have been measured in 30 surface water samples and in 396 fish tissue samples. Arithmetic mean results, by species and for the water samples collected, are summarized in Table ES-1. For fish tissue, PFOS was clearly the dominant analyte in terms of measured concentrations with arithmetic means ranging from 36 to 64 ng/g across the four species. The means for all species for all of the other twelve analytes were less than 4 ng/g and the means were less than 0.5 ng/g for seven of the twelve (PFBS, PFHS, PFBA, PFPeA, PFHxA, PFOA and PFNA). For the surface water samples, arithmetic means were from highest to lowest: PFBA (32 ng/L) > PFBS (12 ng/L) \approx PFOA (10 ng/L) > PFOS (6.1 ng/L) with the means for all other analytes being at or below 5 ng/L.

To elaborate on the PFOS results, the concentration of PFOS in the surface water samples ranged from less than the limit of quantitation (LOQ) up to 136 ng/L with 21 of the samples being less than the LOQ. PFOS concentrations based on the arithmetic and geometric means for Pool 2 were 6.14 and 1.67 ng/L, respectively. The median PFOS water concentration was equivalent to the LOQ. The concentrations of PFOS in the 2011 Mississippi River fish samples ranged from 3.17 to 757 ng/g. Arithmetic mean, geometric mean, and median PFOS concentrations for all fish samples from Pool 2 were 46, 31 and 34 ng/g, wet weight (ww), respectively. The arithmetic means for bluegill, freshwater drum, smallmouth bass, and white base were 36, 46, 39, and 64 ng/g ww, respectively.

Table ES-1. Mean Concentrations of Target Analytes in Fish Tissue (ng/g ww) and Surface Water (ng/L) Samples (ND= 1/2LOQ)

	PFBS	PFHS	PFOS	PFOSA	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnA	PFDoA
Bluegill	0,06	0.42	36	0.08	0.27	0.17	0.19	0.04	0.09	0.10	1.4	0.83	0.59
Freshwater drum	0.09	0.09	46	0.33	0.38	0.18	0.24	0.03	0.12	0.28	1.7	1.1	11
Smallmouth bass	0.06	0.04	39	0.97	0.21	0.21	0.16	0.04	0.08	0.05	1.7	1.2	1.2
White bass	0.06	0.12	64	1.3	0.26	0.15	. 0,20	0.03	80.0	0.51	3.6	1.8	1.5
Water	12	3.0	6.1	1.0	32	5.1	* 2.2	1.0		1.0	1,0	1.0	1.0

With the exception of PFBS, the agreement between laboratories for reported fish and water sample concentrations was good with the average relative percent differences (RPD) for PFASs and PFCAs generally being 25% or less. Interpretation of PFBS result was confounded by the fact that two of the 30 samples had concentrations greater than the LOQ as reported by both laboratories. For PFOS, the RPD for fish tissue concentrations was generally less than 25%. The interlaboratory comparison of water PFC concentrations was limited due to the large number of non-detects reported by both laboratories. Based on water samples that had reported concentrations from both laboratories, the RPD ranged from 1.6 to 135% with an overall arithmetic average and median of 36% and 33%, respectively. For PFOS, the RPD ranged from 17 to 56% with an average of 35%.

An additional post-study validation exercise, focused on PFOS, was also completed at both the 3M Environmental and AXYS laboratories. This effort included the analysis of blinded duplicate standard reference fish tissues (SRM) from the National Institute of Standards and Technology (NIST) and splits of previously analyzed archived Pool 2 fish tissue samples. Results from this exercise showed good agreement between PFOS concentration measured in this study to that reported in the previous analyses conducted by both laboratories. In addition, PFOS concentration reported by both laboratories for the SRM samples fell within the acceptable range reported by NIST.

This report summarizes the field sampling activities, the analytical procedures followed throughout the study, and the analytical results associated with the Mississippi River fish and water samples.

x Executive Summary Cardno ENTRIX November 2012

Chapter 1

Introduction, Objectives, and Scope of 2011 Fish and Water Collection Efforts

1.1 Introduction and Objectives

The purpose of this study is to provide current and comprehensive site-specific measures of perfluoroctane sulfonate (PFOS) and 12 other perfluorochemicals (PFCs) in fish fillet tissues and surface water samples from Pool 2 of the Mississippi River.

Previous studies have reported varying concentrations of PFOS in a variety of fish species and surface water from various locations within Pool 2 (Weston 2006; MPCA 2010); the current collections are meant to improve the knowledge base concerning PFOS and other PFCs in these media.

The data from this study is intended to be used to evaluate current levels of PFCs in fish fillet tissue and water surface samples from Pool 2. In addition, these data support the formulation of a baseline that can be used to identify and characterize the impact of potential sources throughout the pool as well as evaluate the potential effects of mitigation efforts to reduce PFCs within Pool 2. Furthermore, it was envisioned that data gathered in this study might be helpful in preparing a Total Maximum Daily Loading (TMDL) for PFOS in Pool 2 should the impairment status remain unchanged.

Sample collection and analysis activities were carried out under guidelines introduced in the project work plan titled "Work Plan for the Collection of Fish and Surface Water from Pool 2 of the Upper Mississippi River, Minnesota" (Cardno ENTRIX, 2011) and the Quality Assurance/Quality Control (QA/QC) conditions specified in the associated Quality Assurance Project Plan (QAPP). These documents are available upon request.

1.2 General Site Description

The upper and lower extent of Mississippi River Pool 2 is defined by two dams and locks (see Figure 1-1). The upper extent of this pool is bounded by Lock & Dam #1 (River Mile 847.9) located between Minneapolis and Saint Paul just north of the confluence of the Mississippi and Minnesota Rivers. The lower extent of Pool 2 is defined by Lock & Dam #2 located upstream of Hastings, MN (River Mile 815.2). To date, several studies have evaluated the presence of multiple PFCs in several fish species within Pool 2. Early work was focused on very limited areas within the pool and generally involved small numbers of fish collected. More recently, a study conducted by Minnesota Pollution Control Agency (MPCA) in 2009 (MPCA, 2010) focused on 5 fish species collected from four unequally divided reaches within the pool.

For the current study, a total of 10 sampling reaches of approximately three miles in length were identified between the Ford Dam (Dam/Lock #1) and the Hastings Dam (Dam/Lock #2). The exact size and coordinates of each reach was adapted to take into account factors such as input from Minnesota Department of Natural Resources (MDNR) personnel, conversations with local anglers, amount of suitable habitat for each targeted species, proximity to public access sites and other recognizable landmarks (e.g. public parks and fishing areas, boat launches), etc. The approximate

location of reach boundaries is provided in Figure 1-1 and general descriptions of geographic landmarks that correspond with reach boundaries is provided below. Field crews used these approximate locations as guides and final reach boundaries were selected based upon landmarks and points of reference that could be easily identified in the field. The field crew also incorporated 100-200 m "buffer zones" between reaches.

- Reach 1: Ford Dam (River Mile 847.9) downriver to the Pike Island Daymark (River Mile 844.7R)
- Reach 2: Pike Island Daymark downriver to the ADM Dock Lights (River Mile 841.7L)
- Reach 3: ADM Dock Lights marker downriver to the Farm Bureau Dock Lights (River Mile 838.6R)
- Reach 4: Farm Bureau Dock lights to the tip of Pigs Eye Island #1 (River Mile 835.3L)
- Reach 5: Pigs Eye Island #1 marker downriver to the South St. Paul Access boat launch (River Mile 832.4R)
- Reach 6: South St. Paul Access boat launch downriver to the Merimac Island Light and Daymark (River Mile 829.2R)
- Reach 7: Merimac Island Daymark downriver to the Robinson Rocks Light and Daymark (River Mile 825.9R)
- Reach 8: Robinsons Rocks Daymark downriver to the Grey Cloud Landing & Daymark (River Mile 822.4L)
- Reach 9: Grey Cloud Daymark downriver to the Freeborn Island Light and Daymark (River Mile 818.9L)
- Reach 10: Freeborn Island Daymark down river to the Hastings Dam (River Mile 815.2)

This stretch of river is historically heavily industrialized and populated. Sources of discharge to this water body include municipal storm water, publicly owned treatment works, refineries, airports and industrial facilities.

1.3 Target Analytes

Based on numerous PFC assessments that have been conducted in Minnesota, a broad suite of analytes were targeted in this study (see Table 1-1). The selection of these constituents took into account previous fish tissue monitoring activities, thereby enabling the possibility of comparisons over time. Limits of quantitation for all target analytes were 5 ng/L for water and 0.25 ng/g for fish fillet tissue. This report contains the results for all target analytes.

1.4 Target Fish Species

The target species in this study were smallmouth bass (*Micropterus dolomieu*), white bass (*Morone chrysops*), freshwater drum (*Aplodinotus grunniens*), and bluegill (*Lepomis spp*). These species were chosen for a variety of reasons:

- They represent several species that may be harvested by licensed anglers for consumption;
- They are species that have been previously assessed relative to PFC levels and represent those most inclined to have higher levels; and/or
- They constitute a representative scientific assessment of the water body.

A basic study objective was to collect 10 samples of each species in each of the 10 reaches defined in this study, i.e., total fish collection of 400 specimens.

1.5 Tables and Figures

Table 1-1. Targeted PFCs in Tissues of Fish and Water Samples Collected from the Mississippi River, MN

Compound	Acronym	CAS#	Molecular Formula
Perfluorosulfonates			
Perfluorobutane sulfonate	PFBS	29420-49-3	CF ₃ (CF ₂) ₃ SO ₃ H
Perfluorohexane sulfonate	PFHS	432-50-7	CF3(CF2)5SO3H
Perfluorooctane sulfonate	PFOS	1763-23-1	CF3(CF2)7SO3H
Perfluorooctane sulfonamide	PFOSA	4151-50-2	CF3(CF2)7SO2NH2
Perfluorocarboxylates			
Perfluorobutyric acid	PFBA	375-22-4	CF ₃ (CF ₂) ₂ CO ₂ H
Perfluoropentanoic acid	PFPeA	2706-90-3	CF3(CF2)3CO2H
Perfluorohexanoic acid	PFHxA	307-24-4	CF ₃ (CF ₂) ₄ CO ₂ H
Perfluoroheptanoic acid	PFHpA	375-85-9	CF ₃ (CF ₂) ₅ CO ₂ H
Perfluorooctanoic acid	PFOA	335-67-1	CF3(CF2)6CO2H
Perfluorononanoic acid	PFNA	375-95-1	CF ₃ (CF ₂) ₇ CO ₂ H
Perfluorodecanoic acid	PFDA	335-76-2	CF3(CF2)8CO2H
Perfluoroundecanoic acid	PFUnA	2058-94-8	CF3(CF2)9CO2H
Perfluorododecanoic acid	PFDoA	307-55-1	CF ₃ (CF ₂) ₁₀ CO ₂ H

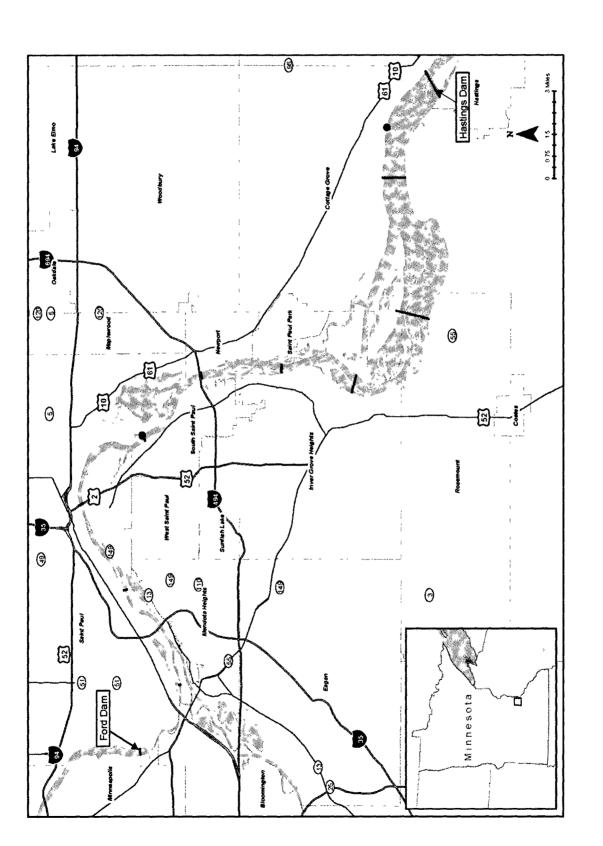


Figure 1-1. Overview of Sampling Area and Approximate Reach Boundaries of 2011 Fish and Water Collection

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November 2012

Chapter 2

Sample Collection Summary

2.1 Fish Collection and Shipment

Electrofishing was the primary sampling method utilized in this effort. Field personnel operated a Smith-Root boat-mounted electrofishing unit with one person navigating and two persons stunning and capturing fish. Non-target species (e.g., channel catfish) were returned to the river. In order to collect fish where electrofishing was not effective, hook and line sampling was also conducted during the last two days of the sampling effort. The sample collection was conducted under a Scientific Collector's Permit granted to Cardno ENTRIX by the MDNR. All practices were conducted in such a way to ensure public and worker safety.

Upon arriving at a given reach, the field crew assessed the area for habitat suitable for the targeted fish species. Once a starting point had been identified, the crew collected GPS coordinates and began an electrofishing "run." Electrofishing runs varied in length depending on the availability of suitable fish habitat, boat traffic, etc. GPS coordinates were collected at the end of each run as well, providing start and end coordinates (See Appendix A, Table A-1). The number of runs conducted in each reach varied but in general, ranged between 10-20 total. Field crew worked both sides of the river in each reach. Figure 2-1 provides an overview of fish collection locations for Pool 2 and the maps in Appendix A show start and end points for electrofishing runs from which fish were collected in a given reach.

Upon collection, fish were placed in clean coolers containing bagged wet ice until the end of a electrofishing run. After this each fish was tagged with a unique ID number and stored in a clean cooler containing bagged wet ice. When the day's collection activities were finished, fish were placed in an individual bag and the bagged fish were then transferred to clean coolers containing double-bagged wet ice. Chain of custody (CoC) forms were filled out for each cooler and placed inside a Ziploc bag. Coolers were taped shut with the CoC form inside and one or more custody seals were affixed to each cooler.

In most cases, coolers were shipped (FedEx or UPS Priority Overnight) at the end of each collection day. Occasionally, fish needed to be held overnight and shipped out the next morning. Shipments were sent to the Wildlife Toxicology Laboratory (WTL) at Michigan State University (MSU). Upon receipt, WTL personnel cross-referenced fish in each cooler against the accompanying CoC form(s). Once the information was verified as correct, the CoC was signed, dated, and stored in a three-ring binder.

2.2 Water Collection

Water samples were collected from 3 locations within each sampling reach (Figure 2-2). However, due to high water levels (Figures 2-3 and 2-4), sampling was conducted in two sampling rounds (see Sections 2.3 and 2.4 for a summary of sampling periods). Water samples were taken from the water column approximately 12 to 24 inches below the surface and from the main river channel and/or locations from which fish were collected. All samples were collected as grab samples using a 1.5 L wide-mouthed Nalgene® polyethylene bottle. Water was then poured from the 1.5 L bottle into

smaller (generally 250 ml) bottles supplied by the analytical laboratories. All water samples (44 total) were sent to the 3M Environmental Laboratory (3M lab) for analysis. Splits of ~68% of the water samples were sent to AXYS for confirmatory analysis. Sample bottles for each set were provided by the respective analytical laboratory. Bottles provided by the 3M lab were weighed and then spiked with internal standard, surrogate, or target analyte for QC purposes prior to providing the bottles to Cardno ENTRIX field personnel. Water samples sent to the AXYS lab were spiked with surrogate standards at the laboratory. Water samples were transported to the laboratory on wet ice and refrigerated until analyzed for PFCs.

In Round 1, GPS coordinates as well as field measurements of water temperature, dissolved oxygen, pH and conductivity were recorded at each sampling location. In Round 2, GPS coordinates, water temperature, and dissolved oxygen measurements were also recorded, but due to equipment failure pH and conductivity measurements were not taken.

2.3 Pool 2 Sampling Rounds

The original study design called for all fish and water sampling activities to be completed in a two to three week period commencing May 31st. However, due to precipitation events preceding the start of field efforts, water levels in Pool 2 were highly variable and elevated (see Figures 2-3 and 2-4). As a result of these unusually high water levels, electrofishing was hampered by at least the following factors:

- Defined structure (e.g., rip rap, downed timber, etc) where fish would normally hold was under significant amounts of water and therefore not available;
- High river current decreased the general effectiveness of electrofishing and specifically the amount of time the crew had to net stunned fish;
- Water clarity was extremely low (< 3ft) making fish capture more difficult; and
- Increased safety concerns related to high current and invisible underwater obstacles.

Accordingly, after a concerted two week effort, a decision was made to postpone fish and water collection and resume a few weeks later after water levels had dropped. With the suspension of fish collection efforts due to high water levels, it was decided that the full longitudinal water sample collection needed to be repeated with the next round of sampling. Accordingly, it is the full set of water samples collected on August 11, 2011, (Round 2) that is considered primary for this study.

At the close of the scheduled August sampling period, the number of fish collected was at approximately 90% of the study objective. In an effort to meet the study objective of 10 fish per species per reach, a third sampling period was arranged for early September.

In summary, three sampling trips, or rounds, were required to complete the fish collection. Round 1 took place from May 31-June 9; Round 2 from August 1-10, and Round 3 from September 11-15. Details concerning each of these sampling periods are provided in Section 2.4.

2.4 Fish and Water Collection Rounds

2.4.1 Round 1: May 31 – June 9, 2011

A total of 148 fish and 14 water samples were collected during Round 1 (Table 2-1).

During discussions leading up to the field effort, MDNR fisheries biologists informed Cardno ENTRIX and Cardno JFNew personnel that large (> 5 in) bluegills were relatively scarce in Pool 2 and that target numbers of bluegill may be hard to collect in all reaches. Therefore, the work plan called for the collection of any *Lepomis* species including sunfish as they share many similar traits (e.g., preferred prey and habitat) with bluegills and would likely be a suitable surrogate species in the event that target numbers of bluegill could not be collected from a given reach or reaches.

One sunfish was collected from Reach 2 during Round 1. Since this fish was the only *Lepomis* individual collected from Reach 2, the decision was made to process and analyze the fish because at that time, it was not clear whether or not the field crew would be able to collect 10 bluegill of sufficient size from Reach 2. Ultimately, 10 bluegill were collected and analyzed from this reach. As a result, the data from the sunfish is not presented in this report but PFC results can be found in Appendix A, Table A-1.

During Round 1, a total of 15 drum were collected from Reach 10. The extra 5 drum (beyond the study objective of 10) were collected in error when the field crew inadvertently did not check the drum tally sheet upon ending an electrofishing run. The error was caught by the MSU lab during sample check-in and the decision was made to process the drum in sequential order, send the first 10 drum for PFC analysis, and archive the extra 5.

During Round 1, water sample collection was conducted in Reaches 1, 2, 3, 8, and 10 as those reaches are where the majority of fish were collected. A total of 14 water locations were sampled at this time. Splits of each water sample were provided to the 3M and AXYS labs as part of the data validation process. Results from these water samples were used only for the interlab comparison (As previously discussed the Round 2 samples are considered the primary data from this study).

2.4.2 Round 2: August 1 – August 11, 2011

A total of 206 fish and 30 water samples were collected during Round 2 (Table 2-2). Pool 2 water levels and current were decreased from Round 1 conditions.

One green sunfish was collected from each of Reaches 4 and 5 during Round 2. These fish were processed and analyzed. The rationale for keeping the green sunfish was that the majority of bluegill that had been collected through Rounds 1 and 2 were small (4-5 in) and it was not apparent if the bluegill would yield sufficient tissue mass for PFC analysis. In addition, there was still doubt that the target sample size of 10 bluegill per reach could be obtained. Ultimately, 10 bluegill were collected and analyzed from all reaches. As a result, the data from the green sunfish are not presented in this report but PFC results can be found in Appendix A, Table A-1.

Water samples were collected on August 11, 2011, from all reaches (3 samples per reach) and delivered to the 3M lab. AXYS received a subset of the water samples from reaches that had not been sampled in Round 1 (3 samples from Reaches 4, 5, 6, 7, and 9 each, plus 1 sample from Reach 10) for a total of 16 samples. When combined with the 14 water samples collected in Round 1, a grand

total of 30 water samples, 3 from each of the 10 reaches were shipped to AXYS. Results from the samples sent to AXYS were used for the interlab comparison.

2.4.3 Round 3: September 11 – September 15, 2011

A total of 51 fish were collected during Round 3 (Table 2-3). Pool 2 water levels and current had decreased compared to Rounds 1 and 2 and the visibility had improved.

In order to reach study objectives, the field crew mainly focused on freshwater drum and white bass during this effort. An extra bluegill was collected from Reach 9, bringing the bluegill collection total to 11 from Reach 9. The extra bluegill was collected because the 10th bluegill kept was a small fish and the field crew was not certain whether sufficient tissue mass could be obtained for analysis. It was later determined during processing at the MSU lab that the 10th bluegill was large enough for analysis so the extra Reach 9 bluegill was archived and not sent for analysis.

No water samples were collected in Round 3 since a full representative set was obtained in August.

2.5 Fish Lengths and Weights

Fish length (cm) and weight (g) was recorded prior to filleting. Fish age (yr) was determined from otoliths. Condition factors (K) were determined as K= Weight*100/ Length³. Average values for target fish species analyzed for PFCs are provided on a whole pool basis in Table 2-4 and on a reach-specific basis in Table 2-5.

2.6 Field QA/QC Measures

Collection equipment used during investigation activities that could come into contact with potentially chemically affected materials were thoroughly cleaned with Liqui-Nox ® (a laboratory-grade detergent) and rinsed with deionized (DI) or distilled water.

Four field equipment blank samples (Field IDs: FEB060111W1, FEB060211F1, FEB060611W1, and FEB081111W1) were collected during this effort. These samples were generated by pouring laboratory reagent water supplied by the 3M lab in/over equipment that could come into contact with samples during the field effort such as the 1.5 L polyethylene water sample collection bottle and a cooler used to hold fish. This water was then poured directly into a sample container(s) and sent to the 3M lab for analysis. A set of field blank samples was provided by the 3M lab during Rounds 1 and 2. Each set of field blank samples consisted of a field blank (Milli Q water), and a 25 ng/L trip blank spike, which were prepared at the 3M lab and sent with the sample bottles for each sampling round.

In addition, consumable samples utilized in the field effort such as acetonitrile gloves, polyethylene bags, etc. were analyzed at the 3M lab prior to study commencement to confirm the presence/absence of PFCs.

Field efforts were documented on bound, waterproof field logbooks with waterproof ink. Deviations from protocol described in the work plan and/or QAPP were documented and, if necessary, corrective action documents were generated.

Sample Collection Summary 2-5

2.7 Tables and Figures

Table 2-1. Fish and Water Sample Collection Summary During Round 1 (June 2011)

					Samp	Sampling Keach					
Species	-	2	က	4	2	9	7	&	6	10	Total
Bluegill	9										8
Freshwater drum	2	_	Ω	ı	I	ı	-	თ	10	ıo	46
Smallmouth bass	6	10 10 10 10 10 10 10 10 10 10 10 10 10 1	2				4.				7
Sunfish	ı	.	ı	ı	ı	ı	1	1	ı	I	-
White bass			2			g 447) a			No. of the State o		. 8
Water	က	က	က	I	1	ł	I	က	ı	2	14

⁻ Not sampled during this round

Nover.

Mississippi River Pool 2 PFC Assessment – Fish Tissues and Water – Summer 2011

Table 2-2. Fish and Water Sample Collection Summary During Round 2 (August 2011)

					•						
Species	-	2	m	4	r.	9	7	80	6	10	Total
				r	8		6	6	TO .	2	99
Freshwater drum	2	2	2	9	6	10	~	_	I	1	39
Green sunfish								jār.			
Smallmouth bass	~	10	80	9	10	10	9	6	4	ı	64
White bass											
Nater	က	ო	ဇ	က	က	က	က	က	က	က	30 1

1AXYS received a subset of the round 2 water samples

- Not sampled during this round

Table 2-3. Fish Sample Collection Summary During Round 3 (September 2011)

					•	Sampling Reach	ıch				
Species	-	2	က	4	5	9	7	œ	6	10	Total
III Denia		A C THE	* ** *** **** ****						2		
Freshwater drum	ı	4	က	4	~	ı	∞	ı	I	ı	20
Smallmouth bass										* * * * * * * * * * * * * * * * * * *	
White bass	4	١	l	2	7	2	1	1	2	ł	17
Not sampled during this round	iring this round										

Cardno EN

Cardno ENTRIX

Sample Collection Summary 2-7

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Table 2-4. Descriptive Statistics for Sample Size, Age, Length, Mass and Condition Factor of Target Fish Species Collected from Pool 2

•			Species	
Characteristic	Bluegill	Freshwater drum	Smallmouth bass	White has
	100 (3 (2.0) 15 (2.4) 77 (42)	100 9.9 (5.8) 36 (5.0) 657 (424)		
Condition Factor (K)	2.304 (0.597)	1.354 (0.685)	1.406 (0.164)	1.313 (0.352)
Arithmetic mean and standard deviation in parer	parentheses			

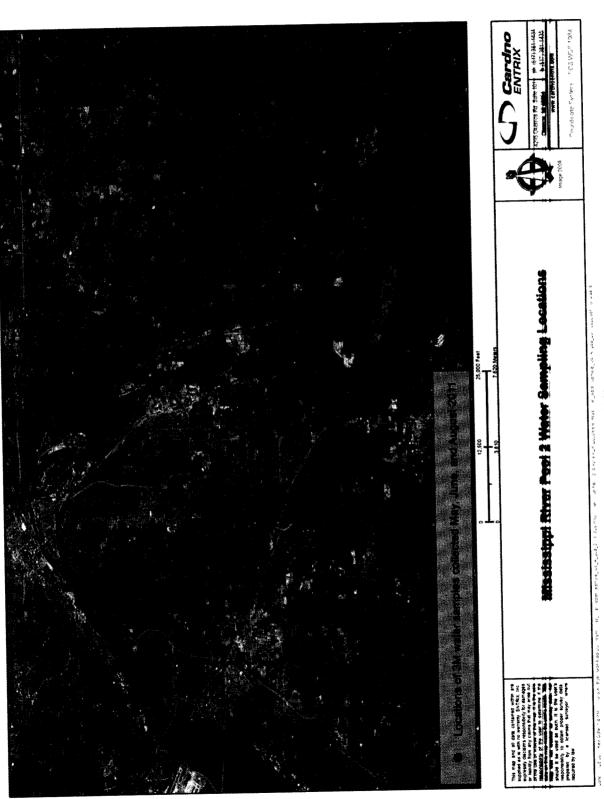
Table 2-5. Descriptive Statistics for Sample Size, Age, Length, Mass and Condition Factor (CF) of Target Fish Species Collected from Pool 2 by Reach

Mississippi River Pool 2 PFC Assessment – Fish Tissues and Water – Summer 2011

							6						
00,000		-	2		د	4	5	9	7		&	6	10
Species	6.20	-	200	The state of the s	M. see	8.	10 Amagan, 17	3 7 4 5				, c	/4, Uk
	Number (N) 10 10 10 10 10 10 10 10 10 10 10 10 10	10	e 4		9	e 8	9. 8.	9 50	ř (3		≥ %	2.0	2 2
	Avo Lenath (cm)	8.7	454		5.2	13.5	13.8	15.0	<u>rei</u>	0	14,4	15,8	7:24
	Avg Mass (g)	72.6	2.62		24	000	7 69	79.4	22	&	75.6	1.66	2
	AVGCE	2.24	2,02	7.	382	2,301	2.422	2.001	25	25	2377	2.276	2.457
	Number (N)	9	19		10	10	10	10	10	C	10	10	10
	Age (yr)	9.5	6.9		7.0	10.0	11.7	10.3	13	13.6	8.7	13.0	8.2
Freshwater drum	Freshwater drum Avg Length (cm)	36.1	32.8		32.0	37.7	37.8	33.4	40.1	<u> </u>	32.4	37.9	36.4
	Avg Mass (g)	589	455		386	1210	775	543	871	Σ-	416	691	637
	Avg CF	1.222	1.236	·	1.145	2.265	1.346	1.401	1.3	.305	1.170	1.220	1.231
Miles 8 Miles 18 Mile	* Number (N)	9		Page 1	10		94	. 02	\$ 10 mm	i a ' f i b, L o i	, ₄	Q	2
		31	500		3.1	3.5	2.7	2.9	• (M)	w	5 2		ဗ္ဗ
	Avg Age (VI)	H		***5	29.2	34.5 34.5	306	303	83. 	 	28.9	32.2	32.6
Smallinouni Dass	Smallingum bass Avy Cengui Veni				. Z	692	926	436	, F	515	342	293	214
	Avgor	#FT]#	. S		.450	1,57	134	1,466	7	361 ** **	1,328		1.378
	Number (N)	9	10	ļ	10	10	10	10	τ-	9	10	10	19
	Avg Age (yr)	4.8	4.8	~	5.5	4.3	4.4	5.3	ന	3.6	5.6	5.0	4.4
White bass	Avg Length (cm)	33.2	37.2	7	36.5	34.5	35.1	37.4	က်	33.4	29.3	34.6	29.2
	Avg Mass (g)	544	809	&	999	265	009	869	₩D	10 6	336	58	\$
	Avg CF	1.28	1.172	. 22	1.361	1.411	1.372	1.330	-	.226	1.235	1.513	1.202

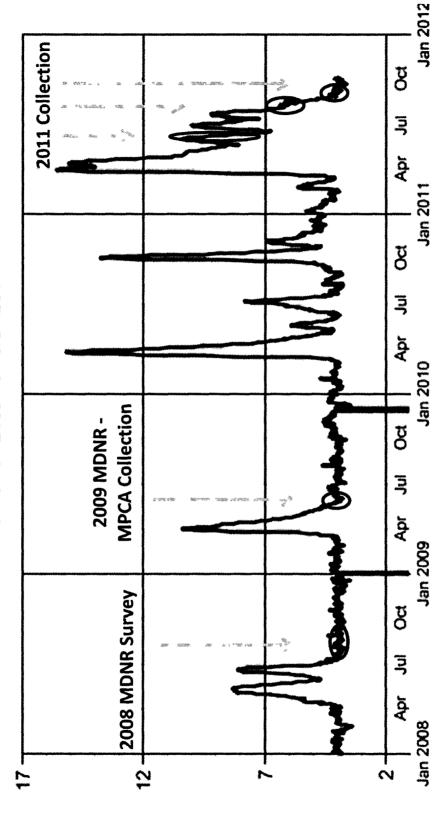
Figure 2-1. Fish Collection Locations for Pool 2 of the Mississippi River, 2011

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Mississippi River Pool 2 PFC Assessment – Fish Tissues and Water – Summer 2011

Figure 2-2. Water Sampling Locations for Pool 2 of the Mississippi River, 2011



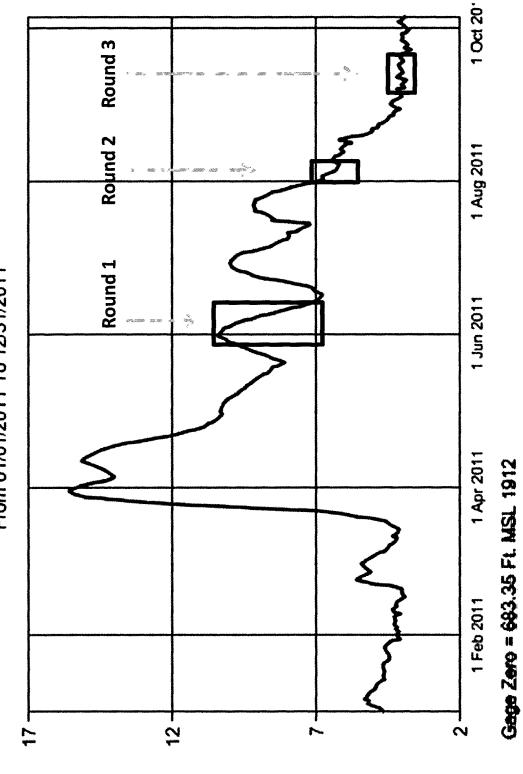
Pool Level in Feet

Gage Zero = 683.35 Ft. MSL 1912

Figure 2-3. Mississippi River Pool 2 Water Levels 2008-2011

Sample Collection Summary 2-11

Mississippi River at South St. Paul (CP2) From 01/01/2011 To 12/31/2011



Pool Level in Feet

Figure 2-4. Mississippi River Pool 2 Water Levels During 2011 Fish and Water Collection

Chapter 3

Sample Handling and Processing

3.1 Sample Tracking

Sample labeling, preservation and tracking procedures were conducted as outlined in project-specific Standard Operating Procedure (SOP) documents and as detailed in the project QAPP.

The following field observations and measurements were recorded:

- Species and number of fish collected;
- Field ID associated with each fish;
- General location of fish collection (See Section 2.1 and Appendix A for more information);
- Date and approximate time of collection (beginning/ending time of electrofishing run); and
- Initials of field crew

3.1.1 Sample ID key

Unique IDs were assigned to individual fish tissue samples to ensure accuracy in sample tracking. The section below describes the sequence of ID assignment and a description of each ID. All IDs listed below are in the project database.

3.1.1.1 Field ID

Upon collection in the field a tag displaying a number (started with 001) was affixed to each fish (through the mouth or jaw). This number is the field ID associated with that individual fish.

Example Field ID: 008 (the eighth fish collected)

3.1.1.2 Tissue ID

Tissue IDs were assigned to individual fillet samples during the filleting process. Each tissue ID consists of the three-digit field ID number and a two-letter abbreviation "FN", indicating the tissue type (fillet, skin-on). All fish samples were scaled and skin-on fillets.

Example Lab ID: 008FN (the eighth fish collected, fillet skin-on)

Field ID	Tissue ID
008	008FN

3.1.1.3 Lab ID

Lab IDs are tissue IDs with a single number appended that ensures tracking of samples sent to the two analytical labs.

Example Lab ID: 008FN2 (the eighth fish collected, fillet skin-on, tissue split #2)

Field ID	Tissue ID	Lab ID
008	008FN	008FN2

3.2 Fish Filleting and Homogenization

The processing of fish tissue samples was consistent with methods previously established by Cardno ENTRIX. Fillets were removed from fish based on United States Environmental Protection Agency (USEPA) guidelines (USEPA, 2000). The fillet type for all fish species was scaled and skin-on (major bones removed), which is consistent for data used by the Minnesota Department of Health (MDH) to establish fish consumption advisories for these species. Given the species and size of fish that were collected in the study, a single fillet was collected from each fish for homogenization. For smaller fish such as bluegill, however, fillets from both sides of the fish were sometimes collected to achieve necessary tissue mass for analysis of PFCs.

Prior to filleting, fish were sorted by species, size, and reach in accordance with sample handling procedures. Before filleting, each fish was photographed and the length and mass of each fish was recorded in carbon-copy laboratory notebooks. Otoliths were removed from each fish and stored for aging. All fish samples were filleted on the day they were received. Fillets from individual fish were deposited into clean and labeled polyethylene bags that were labeled with fish ID number, date collected, species, and reach collected. The fillet samples were stored frozen in accordance with the QAPP until they were homogenized.

Homogenization was performed using a freeze-fracture technique in accordance with the appropriate Cardno ENTRIX SOP. Briefly, fish fillets were transferred from polyethylene storage bags into a Robot Coupe® industrial food processor and enough liquid nitrogen was added to ensure sample solidity. The tissue was then homogenized until a smooth, sawdust-like texture was achieved. The homogenate was distributed to several analytical-grade sample containers and stored frozen in accordance with the QAPP until shipment to the analytical laboratory or laboratories.

Blind duplicate samples were designated during the filleting process (see section 3.2.1 for more details). All remaining fillet tissue was deposited into clean polyethylene bags and stored prior to shipping to 3M for archiving. The carcass and any other materials from each fish were disposed of using the appropriate methods for handling biological materials as outlined by Michigan State University regulations.

3.2.1 Blind Duplicate and Interlaboratory Comparison Samples

In accordance with the QAPP, approximately 10% (41 total) of all fish tissue samples were split and sent in duplicate to the 3M lab. These splits were prepared as "blind" samples so that laboratory personnel were not able to tell that both tissue splits were from the same fish. In all cases, when a blind duplicate sample was created from a given fish, an additional tissue split was generated for AXYS as part of the interlaboratory comparison.

Blind duplicate samples were designated during the filleting process by selecting every tenth sample on the chain of custody and assigning a Field ID number that was withheld from circulation prior to commencing field efforts and randomly selected during fish filleting. If the 10th sample mass was less than 60 grams, the following sample (11th) was selected until a fish with sufficient tissue mass was encountered.

As an example, a blind duplicate sample was created based on the fish with Field ID 010 and the following steps were taken:

- 1) Verify that selected fish is large enough to generate multiple tissue splits;
- 2) Create primary 3M and AXYS tissue splits (Lab IDs 010FN1 and 010FN2); and
- 3) Create duplicate sample for 3M and assign "blind" ID; in this case the Lab ID for the 3M blind duplicate sample was 012FN1.

The following table illustrates the relationships between the various tissue splits and IDs.

Field ID	Tissue ID	Lab ID	Notes
010	010FN	010FN1	Primary 3M sample
010	010FN	010FN2	AXYS split
010	010FN	012FN1	3M blind duplicate

3.3 Sample Processing QA/QC Measures

The sample processing area and equipment at the WTL was decontaminated using general laboratory techniques including washing of sample processing equipment in Liqui-Nox detergent followed by copious rinsing with tap water and then generous rinsing with ASTM type II reagent water. Equipment then received an acetone rinse followed by a methanol rinse. Solvents were allowed to evaporate from the equipment surfaces prior to use.

Prior to the initiation of sample filleting, a daily laboratory processing (start) blank was collected. This blank was generated by rinsing a selection of processing hardware (knives, cutting board, bench paper, etc.) with 100 mL of ASTM type II reagent water and collecting the rinsate in a polypropylene sample bottle. After all sample filleting was completed for the day, a second rinse (end) blank was generated using the same protocol. Rinse blanks were frozen in accordance with the QAPP for later analysis, if necessary.

Prior to homogenization, a daily homogenization (start) blank was generated using the technique noted above for the Robot Coupe® bowl, blade, lid, and lab spatula. Fillet tissue samples were homogenized using a freeze-fracture technique employing liquid nitrogen. The homogenate was split into two fractions if the mass was greater than 20 g, and into four fractions if a primary aliquot, sample split, blind duplicate, and archive were requisite. Homogenization end rinse blanks were collected at the conclusion of daily sample processing and all blanks were archived (frozen) in accordance with the QAPP. In total, upwards of 50 processing or homogenization rinse blanks were generated during the study. Since it was not necessary to analyze every blank, the archived blanks were only analyzed if PFCs were detected in QC samples at unacceptable concentrations.

The 3M lab provided the WTL with three control fish tissue samples with known concentrations of PFOS to evaluate for contamination before, during, and after the sample processing (homogenization, splitting) was completed at the WTL. These tissue samples underwent the same homogenization and splitting process as did all the other fish tissue samples. One control fish tissue sample (bass fillet, "pre-study process control") was subjected to the homogenization process prior to the processing of any experimental samples. Analytical results for the pre-study sample were determined to be acceptable and indicated no laboratory contamination issues, therefore processing was initiated. The

second control fish tissue sample (bluegill fillet, "mid-study process control") was processed in between samples 164FN and 165FN. The third control fish tissue sample (bluegill fillet, "post-study process control") was processed at the conclusion of the project. The IDs reported in 3M analytical reports for these control fish tissue samples were E11-0356-01-001, E11-0356-01-316, and E11-0356-01-443, respectively. See Section 5.2 for more discussion of results associated with control fish tissue samples.

3.4 Post-Study Fish Tissue Evaluation

In addition to the QA/QC procedures outlined in the original QAPP, additional fish tissue samples were sent to 3M and AXYS for a post-study PFOS analysis in November 2011. The goal of this study was to further evaluate potential interlaboratory differences as well as to assess the accuracy and precision of the individual laboratories. The additional samples were comprised of tissues from three sources: National Institute of Standards and Technology standard reference material (NIST SRM) for lake trout tissue from Lake Superior (SRM 1946) and Lake Michigan(SRM 1947) for which PFOS values have been generated and were provided to Cardno ENTRIX (personal communication with Dr. Michele Schantz of NIST); splits of control fish tissue provided by 3M (see last paragraph of Section 3.3 for more detail) which were analyzed previously as part of the primary PFC study; and tissues from fish collected from Pool 2 which were also analyzed previously as part of the primary PFC study.

The post-study samples were analyzed for PFOS following the same methods employed for the analysis of the fish collected in the summer and fall of 2011. Cardno ENTRIX started with 8 samples: 2 NIST SRM tissue samples, 3 control fish tissue samples provided by 3M, and 3 Mississippi River fish tissue samples that were collected and analyzed as part of the primary study. Four duplicate tissue splits were created from each of these samples and all splits were assigned four-digit IDs that were blind to the analytical labs. Two duplicates were provided to both the 3M and AXYS labs for a total of 16 samples per lab (Table 6-16). Tissue samples were split at WTL facilities and shipped for overnight delivery in coolers containing ice. The sample processing area and equipment was decontaminated using the same techniques described previously.

Chapter 4

PFC Analysis by 3M and AXYS

4.1 Sample Preparation and Analysis: 3M Environmental Laboratory

4.1.1 Fish Tissue Samples

Once received at the 3M lab, all samples were checked into the electronic laboratory information management system (LIMS) where each sample was assigned a unique 3M LIMS sample ID and then stored frozen until they could be prepared for analysis. Analysis of fish tissues followed the validated 3M lab method ETS-8-045.1 "Determination of Perfluorinated Alkyl Acids (PFAAs) via Protein Precipitation of Fish Tissues (Fillet or Whole Body) and Analysis by High Performance Liquid Chromatography with Tandem Mass Spectrometry" (Malinsky et al., 2011). Briefly, samples were prepared for analysis by re-homogenizing with dry ice and allowed to sit overnight, or longer, in a refrigerator to allow the dry ice to dissipate. Then, duplicate 0.5 grams aliquots of each sample were transferred to centrifuge tubes, with accurate weight of each aliquot determined. Each analytical batch typically consisted for 20 samples extracted in duplicate with the following QC elements: (1) for every 10th fish sample, two additional aliquots were prepared as laboratory matrix spike (LMS) preparations with a low-level LMS fortified with predominately linear isomer reference material at a nominal 2.0 ng/g each and second high-level LMS fortified at 40 ng/g each; (2) a set of calibration standards that was fortified with internal standards (IS), surrogate recovery standards (SRS), and predominately linear forms of each reference materials, with the exception of PFOSA which was a technical grade material; (3) a set of normal "linear isomer" laboratory control spikes (LCS) consisting of control bluegill homogenate fortified with linear reference materials and technical PFOSA; (4) a set of ECF-LCS samples consisting of control bluegill homogenate fortified with technical PFOS (30.3% branched isomers), technical PFOA (22.2% branched isomers), and technical PFHS (15.6% branched isomers); (5) method blanks consisting of bluegill homogenate with and without ISs and SRSs, and (6) solvent blanks prepared with and without ISs and SRSs.

Each sample aliquot received a fixed quantity of stable isotope labeled internal standard and surrogate for use in quantitation and for evaluation of analyte recovery, respectively. The LCS samples were used to determine the accuracy (average recovery) and precision (RSD) for the PFC analytes. PFC recovery was determined directly via LMS in 10% of the samples. In some samples prepared as LMSs, the endogenous PFC levels were greater than the low-level LCS concentration and were insufficient for proper analyte recovery determination. Those samples were re-prepared with a higher level LMS and the original samples results were not used. In the remaining samples, PFC recovery was based on the measurement result of the appropriate surrogate. Each batch of samples had two freshly prepared sets of LCSs, each consisting of 3 levels of nominal 1.00 ng/g, 10.0 ng/g, and 100 ng/g concentrations of each target analyte. The first set of LCS samples were fortified with "normal" linear isomer reference materials (PFOA, PFHS, PFOS, and PFOSA) similar to that used to construct the calibration standards. The second set of LCS samples were fortified with mixed linear and branched PFC isomers (PFOA, PFHS, and PFOS) to verify the quantitative accuracy of PFC compositions that are typically found in environmental samples.

Extraction of each sample was performed by an acetonitrile protein precipitation method followed by centrifugation and transfer to autosampler for analysis by high performance liquid

chromatography/tandem mass spectrometry (HPLC/MS/MS). Pertinent instrument parameters, the liquid chromatography gradient program, and the multiple mass transitions (Table 4-1) used to analyze PFCs are outlined in Malinsky et al. (2011) as well as in the 3M Laboratory analytical reports. The relative percent difference (RPD) of duplicate analytical sample results was used as a measure of sample-specific analytical precision. The determined recoveries of fortified target analytes from LMS samples were used as a measure of sample-specific analytical accuracy while the recovery of SRSs in each analytical sample was used as a secondary measure of target analyte recovery from each sample.

4.1.2 Surface Water Samples

Analysis of water samples followed the 3M lab Method ETS-8-154.4 "Determination of Perfluorinated Acids, Alcohols, Amides and Sulfonates in Water by Solid Phase Extraction and High Performance Liquid Chromatography/Mass Spectrometry" (Wolf et al., 2011). Briefly, all samples, calibration standards, and associated quality control samples were extracted by passing 50 mL water samples through a pre-conditioned solid phase extraction (SPE) cartridge followed by the elution of PFCs with 2.5 mL methanol. Surface waters samples were extracted using a Waters tC18 \$PE cartridge (0.5 g, 3 cc) for PFNA, PFDA, PFUnA, PFDoA, PFBS, PFHS, PFOS, PFOSA, ¹³C₄-PFOS and ¹³C₂-PFUnA. An Oasis HLB SPE cartridge (0.5 g, 3 cc) was used to extract PFBA, PFPeA, PFHxA, PFOA, and ¹³C₄-PFOA. This procedure concentrates the samples by a factor of twenty-five. All samples and quality control samples were analyzed for 13 target analytes using high performance liquid chromatography/tandem mass spectrometry (HPLC/MS/MS). Pertinent instrument parameters, the liquid chromatography gradient program, and the specific mass transitions analyzed (Table 4-1) are described in their respective 3M analytical reports. Three types of blanks were prepared and analyzed with samples including method blanks, solvent blanks, and field/trip blanks. Each blank result was reviewed and used to evaluate method performance to determine the LOO for each analyte.

Calibration standards were prepared by spiking known amounts of PFC analytes into Milli Q water and internal standards were added from a separate spiking solution at the same levels as those used in water samples, 0.1 ng/ml. A total of 12 spiked standards were prepared. The data for each analyte was fitted to a quadratic, weighted calibration curve that was not forced through zero. If necessary, low and/or high curve points were disabled to help meet linearity or accuracy criteria of $100 \pm 25\%$ ($100 \pm 30\%$ for the lowest curve point). The limit of quantitation (LOQ) was defined as the lowest non-zero calibration standard in the calibration curve that met linearity and accuracy requirements.

Laboratory control spikes (LCSs) were prepared by spiking analytes into Milli Q water to produce three concentrations: low, mid and high. In Round 1, all PFCs and SRSs were spiked at nominal concentrations of 5, 50, and 500 ng/L with the exception of PFBA, which was spiked at 10, 50, and 200 ng/L. In Round 2, PFNA, PFDA, PFUnA, PFDoA, ¹³C₂-PFUnA, PFBS, PFHS, PFO\$ (linear), and PFOSA were spiked at a nominal concentration of 5, 50, and 500 ng/L. For PFBA, PFPeA, PFHxA, PFHpA, PFOA (linear), and ¹³C₄-PFOA nominal spike concentrations were 5, 50, and 250 ng/L. For PFOS and PFOA that contained both linear and branched isomers, samples were spiked at 5 and 500 ng/L. The spiked water samples were extracted and analyzed in the same manner as the water samples.

Field matrix spikes (FMS) were collected at each sampling point to verify that the analytical method was applicable to the collected matrix. FMS recoveries within the method acceptance criteria of $100\% \pm 30\%$ confirm that unknown components in the sample matrix do not significantly interfere

with the extraction and analysis of the analytes of interest. Samples were collected in 250 ml Nalgene bottles spiked with 25 ppt (nominal) field matrix spike that were marked with a "fill to line" line at 200 ml. In Round 1, five of the 12 samples were overfilled by more than 10% while in Round 2, 15 of 30 samples were overfilled. In each of these instances, the true value of the FMS was adjusted based on the volume determined from the pre- and post-fill bottle weights.

4.2 Sample Preparation and Analysis: AXYS Analytical Services

4.2.1 Fish Tissue Samples

Samples were received by AXYS and stored frozen in accordance with the QAPP prior to extraction and analysis. Samples were analyzed in multiple batches; each batch included a procedural blank, a lab-generated reference Ongoing Precision and Recovery (OPR) sample, and a duplicate sample. OPR samples were prepared using a fish tissue that was free of PFCs. Sample extraction, instrumental analysis, and analyte quantification procedures were in accordance with AXYS method MLA-043 "Analytical Procedure for the analysis of Perfluorinated Organic Compounds in Tissues Samples by LC-MS/MS". The surrogate and recovery standards were sourced from Wellington Laboratories® while the authentic standard used in OPR samples was sourced from Sigma Aldrich®. Samples were prepared in batches that consisted of a set of calibration standards, laboratory control samples, blanks, and tissue samples. Briefly, the samples were accurately weighed (approximately 2 g), spiked with surrogate standards (Table 4-2) and extracted in basic methanol by shaking. Extracts were then cleaned up by SPE extraction using disposable cartridges containing a weak anion exchange sorbent. The resulting extracts were instrumentally analyzed using HPLC coupled to a triple quadrapole mass spectrometer (LC-MS/MS) that was run in the multiple reaction monitoring (MRM) mode. Pertinent instrument parameters, liquid chromatography gradient program and mass transitions (Table 4-2) used to analyze PFOS are described in the AXYS analytical report.

Analyte concentrations were determined by isotope dilution/internal standard quantification, comparing the area response of the quantification ion to that of the ¹³C-labeled standards and correcting for response factors. Linear quantification equations with 1/X² weighting fit were determined from a multi-point calibration series using matrix matched calibration solutions prepared alongside the samples. For the calculated concentrations, a maximum of 1 point per calibration solution with a maximum of three points for all the calibration solutions had to fall within 60 to 140% of actual concentrations provided that all remaining points including those for PFOA, PFOS and PFDA fell within 70-130% of actual concentration. A mid-level calibration solution was analyzed at least after every 20th sample with concentrations having to be within 30% of the actual concentrations. The reporting limit was defined as the concentration equivalent to the lowest calibration solution run with a particular batch of samples, or the sample specific detection limit, whichever was greater. The range of acceptable matrix spike recoveries for PFBA, PFPeA, PFBS, PFHS, and PFOSA was 40 to 150%. The acceptable recovery range for ¹³C₂-PFBA was 20 to 150% while for ¹³C₂-PFHxA, ¹³C₂-PFOA, ¹³C₅-PFNA, ¹³C₂-PFDA, ¹³C₂-PFDoA, ¹⁸O₂-PFHS, ¹³C₄-PFOS and ${}^{13}C_8$ -PFOA it was 40 to 150%.

The reported concentrations of PFCs in fish tissues were not blank corrected and the data were evaluated with consideration of the procedural blanks. All linearity, calibration/verification, OPR, duplicate, and labeled recovery samples met the method specifications with the exception of two samples. In one sample the percent recovery of PFUnA in an OPR was slightly above the method upper limit specification and as a result, the concentration reported for this sample may have been over reported. In a second sample, the percent recovery of the surrogate ¹³C-PFBA (154%) was

slightly above the upper limit, but given that the analyte was not detected, it had no effect on the reported value.

4.2.2 <u>Surface Water Samples</u>

Samples were received by AXYS and stored at 4°C prior to extraction and analysis. Samples were analyzed in multiple batches; each batch included a procedural blank, lab-generated reference Ongoing Precision and Recovery (OPR) sample, and a duplicate sample. OPR samples were started with the samples and carried through in the same analytical batch. The blanks were prepared using Canadian Springs TM water.

Sample extraction, instrumental analysis and analyte quantification procedures were in accordance with the AXYS method MLA-060 "Analytical Procedure for the Analysis of Perfluorinated Organic Compounds in Aqueous Samples by LC-MS/MS". Briefly, the unfiltered samples were accurately weighed and adjusted to pH 6.5. They were then spiked with surrogate ¹³C-labeled surrogate standards (Table 4-2) and extracted using SPE with a weak anion exchange cartridge. Eluates were spiked with a ¹³C₂-PFOUEA recovery standard and then analyzed using liquid chromatography/mass spectrometry (LC-MS/MS). Pertinent instrument parameters, liquid chromatography gradient program, and mass transitions used to analyze PFCs (Table 4-2) are described in the AXYS analytical report.

Analyte concentrations were determined by isotope dilution/internal standard quantification, comparing the area response of the quantification ion to that of the 13C-labeled standards and corrected for response factors. Quadratic quantification of the 1/X² weighting fit was determined from multi-point calibration series using matrix matched calibration solutions prepared alongside the aqueous samples. Acceptance criteria for the calculated concentrations based on the initial calibration curve was 75-125% of actual concentration (lowest calibration point may be 70-130%) with a coefficient of determination (R²) of 0.990 or greater. The reporting limit was defined as either the concentration equivalent to the CS0 calibration standard, the lowest calibration solution run with a particular batch of samples, or the sample specific detection limit, whichever was greater. The acceptable OPR recovery range was 80% to 120% for perfluoroalkyl carboxylate analytes while for perfluoroalkyl sulfonates it was 70-130%. With the exception of ¹³C-PFBA, the surrogate standard acceptable recovery range was 40-150% while for ¹³C-PFBA it was 20-150%.

In Round 1, all linearity, CAL/VER, OPR, duplicate, and labeled compound standards met recovery specifications. In Round 2, all standards also met recovery specification with the exception of two samples where ¹³C₂-PFDoA did not meet the criteria and were flagged accordingly. However, given that the isotope dilution method of quantification produces data that are recovery corrected, the slight variance from the method acceptance criteria was deemed to not have significantly affected the quantification of analytes.

4.3 Samples Analyzed

The number fish tissue samples, surface water samples and additional QA/QC samples analyzed by 3M and AXYS for this study are reported in Table 4-3. Table 4-4 reports the number collected and fish species analyzed on a reach-specific basis.

Tables and Figures 4.4

Table 4-1. Target Analytes and Surrogate Standards for 3M Environmental Laboratory

		Water	Fish
Compound	Analyte Description	MRM Transition(s)	MRM Transition(s)
Target Analytes	章		
PFBA (C4 Acid)	Target	213>169	213>169
PFPeA (C5 Acid)	Target	263>219	263>219 263>119
PFHxA (C6 Acid)	Target	313>119 313>269	313>269 313>119
PFHpA (C7 Acid)	Target	363>319 363>119	363>319 363>169
PFOA (C8 Acid)	Target	413>369 413>219 413>169	413>369 413>219 413>169
PFNA (C9 Acid)	Target	463>419 463>219 463>169	463>419 463>219 463>169
PFDA (C10 Acid)	Target	513>469 513>219 513>269	513>469 513>269 513>219
PFUnA (C11 Acid)	Target	563>519 563>269 563>219	563>519 563>269 563>219
PFDoA (C12 Acid)	Target	613>569 613>319 613>269	613>569 613>319 613>169
PFBS (C4 Sulfonate)	Target	299>80 299>99	299>80 299>99
PFHS (C6 Sulfonate)	Target	399>99 399>80	399>80 399>99
PFOS (C8 Sulfonate)	Target	499>99 499>80 499>130	499>80 499>99 499.130
FOSA (C8 Sulfonamide)	Target	498>78	498>78
Internal Standards (IS)			
[¹³ C ₄]-PFBA	IS for PFBA	217>172	217>172
[¹³ C ₅]-PFPeA	IS for PFPeA	268>223	.
[¹³ C ₂]-PFHxA	IS for PFHxA	315>270	
	PFPeA, PFHxA and PFHpA	2.2.210	315>270
[¹³ C ₅]-PFHpA	IS for PFHpA	368>273	010-210
	r PFOA and [13C4]-PFOA	421>376	421>376
[¹³ C ₅]-PFNA	IS for PFNA	7217010	468>423
		470> 407	400/423
[¹³ C ₉]-PFNA	IS for PFNA	472>427	

Table 4-1. Target Analytes and Surrogate Standards for 3M Environmental Laboratory

	-	Water	Figh
Compound	Analyte Description	MRM Transition(s)	MRM Transition(s)
[¹³ C ₂]-PFDA	IS for PFDA	515>470	5 15>4 70
[¹³ C ₆]-PFDA	IS for PFDA	519>474	
[¹³ C ₇]-PFUnA	IS for PFUnA and [13C2]-PFUnA	570>525	5 65>\$2 0
[¹³ C ₂]-PFDoA	IS for PFDoA	615>570	615 >\$ 70
[¹⁸ O ₂]-PFBS	IS for PFBS	303>84	303⊳84
[¹³ C ₃]-PFHS	IS for PFHS	402>80	402>8 0
[¹³ C ₈]-PFOS	IS for PFOS and [13C4]-PFOS	507>80	50 7> 80
[¹³ C ₈]-PFOSA	IS for FOSA	506>78	50 6>7 8
Surrogate Recovery Standards (SRS)			
[¹³ C ₄]-PFOA	Surrogate (C4-C9 Carboxylates)	417>372	417>3 72
[¹³ C ₄]-PFOS	Surrogate (PFBS, PFHS, PFOS and PFOSA)	503>80	503> 80
[¹³ C ₂]-PFUnA	Surrogate (C10-C12 Carboxylates)	565>520	565⊳520

Multiple MS/MS ion transitions are summed when more than one transition is listed for the analyte.

Table 4-2. Target Analytes and Surrogate Standards for AXYS Analytical Laboratory

Compound	MRM Transition(s)	Quantified Against
Target Analyte		
Perfluorobutanoate (PFBA)	213>169	¹³ C ₄ -PFBA
Perfluoropentanoate (PFPeA)	263>219	¹³ C ₂ -PFHxA
Perfluorohexanoate (PFHxA)	313>269	¹³ C ₂ -PFHxA
Perfluoroheptanoate (PFHpA)	363>319	¹³ C ₂ -PFHxA
Perfluorooctanoate (PFOA)	413>369 413>169	¹³ C ₂ -PFOA
Perfluorononanoate (PFNA)	463>419	¹³ C ₅ -PFNA
Perfluorodecanoate (PFDA)	513>469	¹³ C ₂ -PFDA
Perfluoroundecanoate (PFUnA)	563>519	¹³ C ₂ -PFDA
Perfluorododecanoate (PFDoA)	613>569	¹³C₂-PFDoA
Perfluorobutane sulfonate (PFBS)	299>80 299>99	¹⁸ O ₂ -PFHS
Perfluorohexane sulfonate (PFHS)	399>80 399> 99 399>119	¹⁸ O ₂ -PFHS
Perfluorooctane sulfonate (PFOS)	499>80 449>99	¹³ C ₄ -PFOS
Perfluorooctane sulfonamide (PFOSA)	498>78	¹³ C ₄ -PFOS
Surrogate Standard		
¹³ C ₄ -Perfluorobutanoic acid (¹³ C ₄ -PFBA)	217>172	¹³ C ₄ -PFOA
¹³ C ₂ -Perfluorohexanoic acid (¹³ C ₂ -PFHxA)	315>270	¹³ C ₄ -PFOA
¹³ C ₂ -Perfluorooctanoic acid (¹³ C ₂ -PFOA)	415>370	¹³ C ₄ -PFOA
¹³ C ₅ -Perfluorononanoic acid (¹³C ₅ -PFNA)	468>423	¹³ C ₄ -PFOA
¹³ C ₂ -Perfluorodecanoic acid (¹³ C ₂ -PFDA)	515>470	¹³ C ₄ -PFOA
¹³ C ₂ -Perfluorododecanoic acid (¹³ C ₂ -PFDoA)	615>570	¹³ C ₄ -PFOA
¹⁸ O ₂ –Perfluorohexanesulfonate (¹⁸ O ₂ -PFHS)	403>84 403>103	¹³ C ₄ -PFOA
¹³ C ₄ –Perfluorooctanesulfonate (¹³ C ₄ -PFOS)	503>80 503>99	¹³ C ₄ -PFOA
Glean-up Standard	2 2 4 2 2 2 E	
¹³ C ₈ -Perfluorooctanoic acid (¹³ C ₈ -PFOA)	421>376	¹³ C ₄ -PFOA
Recovery Standard		も
¹³ C ₂ -2H-Perfluoro-2-decenoic acid (¹³ C ₂ -PFOUEA)	459>394	-
¹³ C ₄ -Perfluorooctanoic acid (¹³ C ₄ -PFOA)	417>372	<u> </u>

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Table 4-3. Summary of Samples Shipped to Analytical Laboratories

get Analytes	PEBS, PFHS, PFOS, PFOSA, PFBA, PFPAA, PFHVA, PFDA, PFUñA, PFDOA, PFDOA, PFUñA, PFDOA, PFUñA, PFDOA, PFUÑA, PFDOA, PFUÑA, PFDOA, PFUÑA, PFDOA, PROA, PFUÑA, P	Odlie as abovo
Other QA/QC Samples ¹		1
		30
Interlaboratory Blind Duplicate Fish Tissue Samples		1
Fish Tissue Samples	7,000	413
- -		AXYS

1 Field and MSU laboratory equipment rinsate blanks and control fish tissue processing blanks

² Includes 396 target species plus two non-target green sunfish and one sunfish

³ Duplicates of 41 samples sent to 3M

Table 4-4. Species and Number of Fish Analyzed by 3M from Pool 2 of the Mississippi River, 2011

1 2 3 4 5 6 7 8 9 10 drum 10 10 10 10 10 10 10 10 10 bass 10 10 10 10 10 10 10 10 10 6 10 10 10 10 10 10 10 10 10	1 2 3 4 5 6 7 8 9 10 lerdrum 10						3,	Sampling Reach					
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			ž m	## 4	* *		10	10	6	10	10	10	96

1 The first 10 bluegill collected from Reach 9 were analyzed; tissues from an 11th were archived

² The first 10 drum collected from Reach 10 were analyzed; tissues from an extra five (11-15) were archived

- Not sampled during this round

QA/QC Results

5.1 3M Laboratory QA/QC Samples

5.1.1 Fish Tissue QA Results

Calibration curves were not forced through zero and when calculated standard concentrations from the calibration curve were compared to known concentrations, the accuracy of each curve point was within $100 \pm 25\%$ with a coefficient of determination that was greater than 0.990. The lower limit of quantitation (LLOQ) was the lowest non-zero calibration standard in the curve that met linearity and accuracy requirements ($100 \pm 30\%$) and for which the area counts were at least two times that of the average response determined from the method blanks. In this study, the LLOQ for C7-C12 PFCAs, PFBS, PFHS, PFOSA, and the surrogate reference standards was in nearly all instances the nominal concentration of 0.25 ng/g (0.025 ng/ml acetonitrile), or less. However, in no more than eight analytical batches, the LLOQs for PFBA, PFPeA and PFHxA were raised to 0.35 ng/g, 0.5 ng/g, or 1.0 ng/g fish tissue. For PFOS, the required 0.250 ng/g LLOQ was met for all analyses.

Continuing calibration verifications (CCV) were performed during the course of each analytical batch by injection of mid-level calibration standards to help verify instrumental response and that the initial calibration curve was still in control. The average recoveries for all CCVs ($n \ge 190$) from all analytical batches were within $100\% \pm 15\%$ and had RSDs less than 15%. The CCV for PFOSA in all analytical batches met the method criteria of $100\% \pm 25\%$. All other analytes met the same criterion with only a few exceptions. The number of exceptions for each analyte was never greater than 15% of the total number of CCVs and the exceedences typically were not greater than 30% of the acceptable range.

The average LMS recovery for all target analytes ranged from 91.7% to 113% with RSDs less than 20%. Additionally, the average LMS recoveries for the three stable isotope labeled surrogate recovery standards (SRS) showed good precision and accuracy with average recoveries of 107%, 107%, and 112%, and RSDs < 20%, for $^{13}C_4$ -PFOS, $^{13}C_4$ -PFOA and $^{13}C_2$ -PFUnA, respectively. The SRS recovery results from LMSs were similar to the overall accuracy and precision achieved for the SRSs added to fish tissues prior to extraction (sample and sample duplicate, n = 880), with average recoveries and RSDs of $103\% \pm 10\%$ for $^{13}C_4$ -PFOS, $107\% \pm 13\%$ for $^{13}C_4$ -PFOA, and $106\% \pm 11\%$ for $^{13}C_4$ -PFUnA. The results determined from LMSs and SRSs indicated excellent overall data accuracy and precision for the study sample fish results.

The recoveries of fortified PFOS from the 45 LMS samples prepared from samples analyzed throughout the study were within the acceptance criterion of $100 \pm 30\%$ recovery and ranged from 77.1% to 120%, with an average recovery and standard deviation of $102\% \pm 11\%$. Additionally, the surrogate recoveries from all samples were within $100 \pm 30\%$, indicating good analytical accuracy for PFOS in all samples. The average recovery for all $^{13}C_4$ -PFOS surrogate recovery standards in the study samples and duplicates was 99.9% with an RSD of 10.3%. The analytical method uncertainty was determined from the analysis of LCS sets prepared with each extraction batch by spiking PFOS in control fish tissue homogenates at nominal concentrations of 1.0, 10.0 and 100 ng/g. The method

uncertainty was determined to be \pm 17% for linear PFOS (linear isomer) and \pm 19% for PFOS (mixed linear + branched isomers), determined at the 95% confidence interval (i.e. 2 standard deviations).

The LCS average accuracy and precision results for the target analytes in fish tissues were as follows: $113\% \pm 21\%$ for PFBA, $106\% \pm 24\%$ for PFPeA, $102\% \pm 13\%$ for PFHxA, $93.6\% \pm 10\%$ for PFHpA, $96.1\% \pm 15\%$ for PFOA, $99.2\% \pm 11\%$ for PFNA, $102\% \pm 11\%$ for PFDA, $96.7\% \pm 9.7\%$ for PFUnA, $98.9\% \pm 9.8\%$ for PFDoA, $98.8\% \pm 13\%$ for PFBS, $97.0\% \pm 9.8\%$ for PFHS, PFOS $96.4\% \pm 8.9\%$, and $95.8\% \pm 6.9\%$ for PFOSA. Overall, the inter-batch average recovery for linear LCS recoveries were within the $100 \pm 30\%$ with RSDs of less than 20% with the exception of PFBA and PFPeA. The average SRS recovery and RSD for linear LCSs were as follows: $109\% \pm 12\%$ for $^{13}C_4$ -PFOA, $105\% \pm 8.6\%$ for $^{13}C_2$ - PFUnA and $105\% \pm 8.5\%$ for $^{13}C_4$ -PFOS. The LCS results indicated excellent method performance for all target analytes.

The ECF-LCSs average and RSD recovery results for technical PFHS, technical PFOS, and technical PFOA fortified into bluegill control fillet homogenate were $100\% \pm 8.6\%$, $116\% \pm 8.1\%$, and $87.8\% \pm 13\%$, respectively. The SRS average recoveries and RSDs for ECF-LCSs were $109\% \pm 8.6\%$ for $^{13}C_4$ -PFOA and $104\% \pm 8.7\%$ for $^{13}C_4$ -PFOS. Overall, the ECF-LCS results showed that mixed and linear branched isomer reference materials for PFOA, PFHS and PFOS were quantified with excellent accuracy and precision using linear isomer calibration.

The analytical method uncertainties (95% confidence interval) were determined as two-times the standard deviation of recovery results for all linear LCS samples and were as follows: \pm 48% for PFBA, \pm 50% for PFPeA, \pm 26% for PFHxA, \pm 20% for PFHpA, \pm 28% for PFOA, \pm 22% for PFNA, \pm 22% for PFDA, \pm 19% for PFUnA, \pm 19% for PFDoA, \pm 26% for PFBS, \pm 19% for PFHS, \pm 18% for PFOS, and \pm 13% for PFOSA. Measurement uncertainties for the SRSs were as follows: \pm 25% for \pm 18% for \pm

5.1.2 Surface Water QA Results

For both Round 1 and 2 water collections, correlation coefficients (r) for calibration curves for all PFC analytes and surrogate recovery standards were 0.995 or greater and met the acceptance criteria. During the course of the analytical sequence, several continuing calibration verification (CCV) samples were analyzed to confirm that the instrument response and the initial calibration curve were still acceptable. The method acceptance criteria of $100\% \pm 25\%$ was met for almost all reported data with exception of four instances, one each for PFBA, PFPeA, PFHxA, and PFHpA.

The limit of quantitation (LOQ) for Round 1 water samples was 2.0 ng/L for PFHpA, PFOA, PFNA, PFBS, PFHS, and PFOS while the LOQ for PFBA was 5.0 ng/L. For PFPeA, PFUnA, PFDoA, and PFOSA, the LOQ was 4.0 ng/L. The LOQ for PFHxA and PFDA was 2.5 ng/L. However, for sample 505SF1, the LOQ for PFHxA and PFOSA was 2.0 ng/L while for PFBA it was 2.5 ng/L. In Round 2, the LOQ for nearly all PFCs was 2.0 ng/L. Exceptions were observed for PFBA, PFPeA, ¹³C₄-PFOA, and ¹³C₄-PFOS where the LOQs were 10.0, 5.0, 2.99, and 2.87 ng/L, respectively.

For Round 1 water samples, the low set of LCS samples for PFBA did not met the acceptance criteria with an RSD of 41% while the mid and high sets met method acceptance criteria of $100 \pm 20\%$ with RSDs $\leq 20\%$. For PFPeA and linear PFOA and PFOS, the high curve points were disabled to meet accuracy and linearity criteria. Acceptance criteria were met for all analytes with the exception of the low level set of LCS samples for PFUnA which had an average recovery of 76.6%, with an RSD of 21%. For Round 2 water samples, all three sets of LCS samples for PFNA, PFDA, PFUnA, PFDOA,

PFBS, PFHS, PFOS (linear), PFOSA, $^{13}C_4$ -PFOS, $^{13}C_2$ -PFUnA, PFOA, and $^{13}C_4$ -PFOA met the acceptance criteria of $100\% \pm 20\%$, with an RSD of $\leq 20\%$. For PFBA and PFPeA, the low set of LCS samples were below the LOQ and recovery could not be determined. For PFHxA, all replicates for the high set of LCS samples exceeded the calibration range and were disabled to meet method linearity criteria. When considering all LCS sets, all PFC analytes met the acceptance criteria of an RSD $\leq 20\%$.

Given that reference materials used for quantitation of PFOS and PFOA are predominately linear isomers while surface water samples collected from Pool 2 contain both linear and branched isomers, laboratory control samples (LCS) containing both linear and branched isomers were prepared to evaluate the potential for analytical bias. LCS samples were prepared at the same time as the calibration curve and SPE extraction of the samples. For Round 1 water samples, the average recovery for the low set of LCS samples for PFOA was 66.1%± 7.9%(RSD) and did not meet the method criteria. In contrast the mid set for PFOA and both sets of LCS samples for PFOS met the method acceptance criteria. For Round 2 water samples, both sets of LCS samples met the method acceptance criteria. For PFOS, the low set of LCS samples met method acceptance criteria while 2 out of the 3 replicates in the high set inadvertently did not receive internal standard spikes, therefore recovery could not be calculated. However, the peak count areas for those 2 samples were very similar to the third replicate that was quantified to have a recovery of 109%.

Analytical uncertainty was determined using historical QC data that is control charted and used to evaluate method accuracy and precision. The method uncertainty is calculated as the standard deviation for a set of accuracy results (%) obtained for QC samples. The expanded uncertainty is calculated by multiplying the standard deviation by a factor of 2. This corresponds to a confidence level of 95%. For Round 1 water samples, the analytical uncertainties were \pm 28% for PFBA, \pm 34% for PFPeA, \pm 27% for PFHxA, \pm 24% for PFHpA, \pm 25% for PFOA, \pm 17% for PFNA, \pm 18% for PFDA, \pm 24% for PFUnA, \pm 20% for PFDoA, \pm 22% for PFBS, \pm 17% for PFHS, \pm 32% for PFOS, and \pm 16% for PFOSA. For Round 2 water samples, the analytical uncertainties were \pm 35% for PFPA, \pm 35% for PFPeA, \pm 31% for PFHxA, \pm 27% for PFHpA, \pm 27% for PFOA, \pm 16% for PFNA, \pm 17% for PFDA, \pm 22% for PFDoA, \pm 22% for PFDoA, \pm 22% for PFBS, \pm 17% for PFHS, \pm 23% for PFOS, and \pm 16% for PFOSA.

In Round 1, a total of 6 out of 12 samples met the acceptance criteria for all PFCs in the field matrix spikes. In the 6 samples that did not meet the acceptance criteria, no single exceedence was greater than 40%. The recovery for PFHxA was 31% in one sample while in 4 other samples the recovery for PFPeA ranged from 134% up to 139%. In each instance, the analytical uncertainty was adjusted for these exceedences. The sixth exception, due to the level of analyte detected in the sample, the 25 ppt FMS was not an appropriate spike level for PFBA, PFOA, and PFOS. However, the ¹³C₄-PFOA and ¹³C₄-PFOS surrogates met the method acceptance criteria and as a result, no additional matrix spikes were prepared. In this sample the recovery was 132% and the analytical uncertainty was adjusted accordingly.

In Round 2, a total of 14 out of 30 water samples met the acceptance criteria for all PFCs in the field matrix spikes. In 12 samples, recoveries for PFBA exceeded the criteria and ranged from 135% up to 165%. For PFPeA, 8 samples had recoveries that exceeded their criteria and ranged from 132% up to 163%. In all but two of these instances, the analytical uncertainty was adjusted for the exceedence. For the other two instances, the recovery was within the analytical uncertainty of \pm 35% and no further adjustment was made. For one sample, the 25 ppt FMS was not an appropriate spike level for PFBA, PFPeA, PFOA, PFBS, PFHS, and PFOS due to the low level of analyte detected. However,

the ¹³C₄-PFOA and ¹³C₄-PFOS surrogates met the method acceptance criteria and no additional matrix spikes were prepared.

5.2 Field QA/QC Samples

Four field equipment blanks were analyzed as part of this study. With the exception of PFOS, all target analytes were reported as less than their LOQ in all 4 blank samples. In 3 of the 4 blanks, PFOS was less than the LOQ (2 ng/L), while PFOS was detected in the 4th blank with a reported result of 6.38 ng/L. This sample was a rinsate blank from a cooler used to temporarily store fish during collection. These coolers were routinely washed and rinsed during the collection and it is highly unlikely that cross contamination would occur through contact with coolers.

5.3 Fish Processing QA/QC Samples

In the pre-study process control, concentrations of target analytes in bass tissue that had been homogenized at WTL remained relatively unchanged when compared to non-WTL homogenized tissue. Exceptions to this were observed for PFBA, PFPeA, and PFHxA where concentrations increased by 3.7 ng/g, 0.73 ng/g, and 1.93 ng/g, respectively and for PFHpA and PFOA where concentrations decreased by 0.06 ng/g, and 0.07 ng/g, respectively. The relative percent difference (RPD) for PFBA, PFPeA, PFHxA, PFHpA, and PFOA were 26%, 64%, 22%, and 25%, respectively. In the mid-study process control, only PFOSA did not meet the acceptance criteria with a concentration difference of 0.041 ng/g and a RPD of 85%. In the post-study process control, concentrations in the WTL-homogenized samples were increased from non-homogenized values for PFHxA (0.81 ng/g), PFNA (0.23 ng/g), PFOA (0.11 ng/g), and PFUnA (0.042 ng/g) with RPD values of 154%, 121%, 59%, and 32%, respectively. All other analytes in the three process controls samples, including PFOS, met the acceptance criteria (RPD ≤ 20%) for WTL versus non-WTL homogenized tissue samples. The changes in analyte concentrations observed in the pre-, mid- and post-study process control samples did not appear to be due to gross contamination from the homogenization process at the WTL-MSU laboratory. This is based on the fact that the variability within these sets of process samples were within the acceptance criteria for most target PFCs, including PFOS. Furthermore, the largest variations on a ng/g basis were predominately with the C4-C6 PFCA analytes, all of which were infrequently measured at levels above the LOQs in fish collected from Pool 2 of the Mississippi River. As a result, the changes in PFC concentrations observed between the WTL and non-WTL homogenized samples did not appear to have significantly affected the data reported for fish collected in this study.

A rinse blank (ID HSR060911F1) containing approximately 100 mL of water was generated by WTL personnel prior to the processing of the pre-study control fish tissue sample mentioned above. With the exception for PFOA, PFNA, and PFOS, all analyte concentration reported in this sample were less than their LOQ. For PFOA, PFNA, and PFOS, concentrations reported in this blank were 2.66, 2.30, and 20.8 ng/L, respectively. However, in the fish tissue pre-study control sample (E11-0356-01-001) that was processed after this blank was generated, PFOA, PFNA and PFOS concentrations were reported as 0.209, <0.250, and 0.576 ng/g, respectively, which indicates there was no apparent cross-contamination from equipment to sample.

In addition to the analysis of fish tissues, consumable supplies (baggies, bench paper, rinse water, etc.) used at MSU for fish processing were sent prior to the commencement of the study to the 3M lab for analysis to ensure that contact contamination would not occur by using those supplies during fish processing. The results from the extraction with methanol: water (1:1) and analysis by

LC/MS/MS of those consumable supplies are documented in the 3M final analytical reports and showed all PFCs were less than their respective LOQ, and therefore sufficiently demonstrated that the consumable supplies used at MSU for fish processing did not have significant extractable PFOS at levels that would pose a contact contamination concern.

Chapter 6

PFOS Results

6.1 Intralaboratory Blind Duplicate Samples

PFOS was detected in all 41 of the intralaboratory blind duplicate samples analyzed by the 3M lab. PFOS concentrations ranged from 7.07-305 ng/g ww in the primary fish samples (Figure 6-7). In the blind duplicate samples, PFOS ranged from 7.79-257 ng/g ww. A comparison of the primary and blind duplicate samples showed that PFOS concentrations differed by less than 20% in 38 of the 41 tissue samples. The average relative percent difference (RPD) between the primary and blind duplicate samples was approximately 9% (Table 6-1).

6.2 Interlaboratory Comparison Samples

6.2.1 Fish Tissue

PFOS was detected in all 41 of the interlaboratory fish tissue samples in both laboratories. PFOS concentrations for all fish ranged from 9.33 to 356 ng/g ww from AXYS and 7.07 to 305 ng/g ww from the 3M lab (Figure 6-8; Table 6.2). A comparison of PFOS concentrations measured in individual fish samples indicated good agreement between laboratories. PFOS concentrations reported by AXYS were greater than those from the 3M lab for 38 of the 41 samples with RPDs that ranged from 1.27 to 53.6% with an average value of 16%. When evaluated on a percent difference basis, values ranged from 1.2 to 73% with an average of 19%. While there was a systematic difference in the reported PFOS concentrations between both laboratories, this is not unexpected given the differences in analytical methodologies used at each laboratory (Lindström *et al.* 2009). For instance, the use of linear isomer PFOS calibration with a 499 to 80 MS/MS transition for data acquisition as was used by AXYS, not the 3M lab, can bias high the quantification of mixed branched/linear PFOS in environmental samples by 8% (Riddell *et al.* 2009). Given what is known about the variability in the quantification of PFOS in biological tissues, results from this interlaboratory comparison reinforce the validity of the results of this study.

6.2.2 Surface Water

The interlaboratory comparison of PFOS concentrations in the 30 surface water samples shows good agreement with concentrations reported by 3M being approximately 1.24-fold greater than those reported by AXYS (Figure 6-9). For AXYS, 25 out of 30 the samples had PFOS concentrations less than the reporting limit while for the 3M lab, 23 of the 30 samples had PFOS concentrations below the reporting limit (Table 6-3). For samples where PFOS was detected, concentrations ranged from 3.45 to 84.9 ng/L for AXYS and 2.15 to 136 ng/L for the 3M lab. While the RPD for all 30 water samples ranged between < 1 to 107%, it is important to note that for the five samples where PFOS was detected by both laboratories, the relative percent difference (RPD) ranged from 17% to 56% with an average of 33%.

6.3 Study Fish Tissue Samples

All bluegill, freshwater drum, smallmouth bass, and white bass tissue samples were successfully analyzed for PFOS with concentrations being reported as greater than the limit of quantitation. The

concentrations of PFOS in the 2011 Mississippi River fish samples ranged from 3.17 to 757 ng/g ww. The arithmetic mean, geometric mean, and median PFOS concentrations for all fish from Pool 2 were 46.3, 31.1 and 34.1 ng/g ww, respectively. In total, the number of samples with PFOS concentrations greater than 40 ng/g ww was 165 while there were 11samples with PFOS concentrations greater than 200 ng/g ww. No sample had a PFOS concentration greater than 800 ng/g ww. PFOS concentrations as reported by 3M for each fish are provided in Appendix A, Table A-1.

Summary statistics for species PFOS concentrations for the entirety of Pool 2 are provided in Table 6-4. In Figure 6-1, box plots provide additional summary statistics on a species specific basis for the entirety of Pool 2. By species, the arithmetic mean and its 95% confidence limits are: bluegill - 36 (24-47) ng/g ww; freshwater drum - 46 (32-61) ng/g ww; smallmouth bass - 39 (25-54) ng/g ww; and white bass - 64 (56-72) ng/g ww. The rank order of PFOS concentrations based on arithmetic means from least to greatest was bluegill, smallmouth bass, freshwater drum and white bass with average PFOS concentrations ranging from 36 to 64 ng/g ww. The rank order of PFOS concentrations from least to greatest based on median values was bluegill, followed by freshwater drum, smallmouth bass and then white bass with median PFOS concentrations ranging from 18 to 58 ng/g ww. An examination of the interquartile ranges in Figure 6-1 as a measure of the variation of PFOS concentrations on a species specific basis shows the greatest degree of variation was associated with bluegill and least for white bass.

In general, the concentration of PFOS in the target fish species did not vary greatly between reaches (Tables 6-5 through 6-14). Based on median values, Reach 6 was highest for bluegill, Reach 5 for freshwater drum, and Reach 10 for smallmouth bass and white bass. For bluegill, PFOS concentrations levels generally increased from Reach 1 (where the lowest levels were observed) through Reach 6, decreased in Reach 7 and then steadily increased through Reach 10 (Figure 6-2). For freshwater drum, median values for the reaches only varied between 12 ng/g (Reach 9) to 38.2 ng/g (Reach 5) with no clear patterns evident from upstream to downstream (Figure 6-3). In similar fashion, the median values for smallmouth bass between reaches were relatively uniform with the exception of Reach 10 which had the highest value of 55 ng/g (Figure 6-4). The white bass results showed the least variability and had fairly consistent median values across all reaches with a minimum of 47 ng/g in Reach 3 and a maximum of 71 ng/g in Reach 10 (Figure 6-5).

Correlation analysis was conducted to evaluate the potential association between fish characteristics (mass, length and age) and fillet PFOS concentrations (Table 6-15). Statistically significant, positive correlations between mass and PFOS concentrations were observed for bluegill (p=0.026) and white bass (p=0.024) while a statistically significant, negative association was observed in freshwater drum (p=0.024). However, all these associations were weak with only up to 5% of the total variation being accounted for in both bluegill and white bass while only 9% of the variation was accounted for in freshwater drum. There were no statistically significant (p<0.05) species-specific association between mass and PFOS concentration with less than 2% of the total variation being accounted for by these associations. For length and PFOS concentrations, the only statistically significant correlation was observed for freshwater drum (p=0.006); however, this association was negative and only accounted for approximately 7% of the total variation. There was statistically significant positive association between PFOS concentrations and age for white bass (p=0.010), however this association only accounted for approximately 6.8% of the total variation. Overall, there were no strong associations between mass, length, or age with PFOS concentrations in any fish species collected during the study.

6.4 Study Surface Water Samples

Of the 30 water samples collected in Round 2 (August) from Pool 2, 21 samples (70%) had PFOS concentrations that were less than the LOQ of 2.0 ng/L (Table 6-15; Figure 6-6; Appendix B, Table B-1). The majority of the non-detect samples were collected from Reaches 1 through 4 where all results were less than the LOQ. Of the 9 samples that had measurable PFOS concentrations, the greatest PFOS concentration was measured in Reach 10 at Station 517 (136 ng/L) while the second greatest PFOS concentration was measured in Reach 5 at Station 530 (7.1 ng/L). Both of these locations likely are impacted by point source mixing zones, i.e., they may not be representative of the composite river concentration for that cross section or transect of river. This hypothesis appears to be supported by downstream concentrations that decrease (in the case of Reach 10, rather dramatically). Finally, as presented in Table 6-15, with the exception of Reach 10, the average PFOS concentrations in water samples from all reaches are well below 7.0 ng/L, which is the site-specific Water Quality Criterion for PFOS established by the MPCA (http://www.pca.state.mn.us/cleanup/pfc/index.html). As previously noted, given the nature of the Station 517 result (i.e., likely taken within a point source mixing zone), it is most likely not representative PFOS concentrations in Reach 10 and as such. PFOS concentrations that reflect the actual exposure to fish may be less than the PFOS water quality criterion.

Fourteen water samples were also collected in Round 1 (June) when it was believed that a single sampling period would be needed for the study. These 14 samples were split, sent to both laboratories, analyzed and became part of the interlaboratory validation element of the study. Because the June sampling locations were replicated by the complete sample set collected in August, the results from the June to August collections were compared at these 14 locations. As summarized in Table 6-3, there are no observable differences in PFOS concentrations observed for these specific locations.

6.5 Post-Study Fish Tissue Evaluation

Based on average PFOS concentrations, the relative percent difference between the reported NIST SRM 1945 concentration and those measured by 3M and AXYS labs was less than 10% indicating excellent accuracy by both laboratories (Table 6-20). However, for the NIST SRM 1946 sample AXYS reported PFOS concentrations as less than the LOQ (detection limits reported for the duplicate tissue splits were 4.81 and 5.1 ng PFOS/g, ww) and as a result the accuracy could not be assessed for this sample (Tables 6-17 and 6-18).

Intralaboratory precision was also excellent with RPDs of less than 6 and 10% for all blind duplicate pairs analyzed at 3M and AXYS labs, respectively (Table 6-19). In addition, the average PFOS values reported by 3M and AXYS labs were very consistent, with RPDs ranging from 7-16% providing further support for the overall quality of the analytical data reported by these labs.

6.6 Tables and Figures

Table 6-1. Intralaboratory Blind Duplicate Comparison of PFOS (ng/g, ww) in Fish Collected from Pool 2 and Analyzed by 3M

	_	Primary S	amples	Blind Dupli	cates	
Reach	Species	Lab ID	PFOS	Lab ID	PFOS	Relative Percent Difference
10	Freshwater drum	010FN1	29.1	012FN1	27.4	6.02
10	Bluegill	022FN1	305.0	019FN1	257.0	
8	White bass	033FN1	42.1	042FN1	37.8	10,81
8	White bass	045FN1	59.5	043FN1	51.4	14.6
3	Smallmouth bass	054FN1	30.0	060FN1	27.7	7.97
2	White bass	065FN1	34.9	068FN1	32.8	6.2
r À .	Freshwater drum	078FN1	35.2	.073FN1	.33.1	6.15
1.1	Smallmouth bass	092FN1	13.5	077FN1	13.3	149
. (1 * * * * * * * * * * * * * * * * * *	Smallmouth bass	102FN1	44,2	089FN1	41.6	6.06
7	White bass	113FN1	45.3	090FN1	44.9	0.89
9	Bluegill	126FN1	21.6	105FN1	23.3	7.57
9	Freshwater drum	137FN1	11.9	121FN1	11.6	2.55
7 9 1	White bass	149FN1	71.4	122FN1	68.9	355
10	Smallmouth bass	159FN1	76.7	139FN1	8 2.5	7 29
6	Freshwater drum	170FN1	28.6	147FN1 **	27.7	32
5	Smallmouth bass	180FN1	13.7	169FN1	11.1	21
5	Freshwater drum	192FN1	41.9	173FN1	44.1	5.1 2
5	Smallmouth bass	203FN1	41.9	182FN1	52.7	22.8
× 6	White bass	214FN1	73.4	184FN1	89.8	20.11
4	Smallmouth bass	224FN1	23.5	196FN1	27.9	
Ba 4 . Tan	White bass	232FN1	54.7	210FN1	59.0	754
4	Smallmouth bass	246FN1	18.6	225FN1	19.0	2.13
4	Freshwater drum	258FN1	7.1	228FN1	7.8	9.6 9
1	Freshwater drum	269FN1	40.3	233FN1	39.5	2.01
2	Smallmouth bass	··· e· · · · · · · · · · · · · · · · ·	46.1	244FN1	50.0	8 1 2
7	Smallmouth bass	291FN1	42.3	245FN1	-35.8	16.0
· 7	Smallmouth bass	302FN1	36.8	255FN1	32.7	114
8	Freshwater drum	315FN1	27.0	265FN1	31.6	15.7
6	Freshwater drum	323FN1	14.6	275FN1	13.7	6.3 6
6	Freshwater drum	334FN1	31.3	284FN1	30.4	2.92
. j	White bass	346FN1	34.8	314FN1	40.5	# # # # # # # # # # # # # # # # # # # #

Table 6-1. Intralaboratory Blind Duplicate Comparison of PFOS (ng/g, ww) in Fish Collected from Pool 2 and Analyzed by 3M

		Primary Sa	mples	Blind Dup	licates	
Reach	Species	Lab ID	PFOS	Lab iD	PFOS	Relative Percent Difference
. 3	Smallmouth bass	360FN1	32.6	324FN1	33.0	1.22
2	White bass	370FN1	66.3	327FN1	52.1	. 24
8	Smallmouth bass	383FN1	40.1	339FN1	35.8	11.3
9	Smallmouth bass	390FN1	9.5	347FN1	8.3	14
5	White bass	400FN1	56.7	348FN1	57.6	1.57
1	White bass	411FN1	62,2	357FN1	67.3	7.88
9 9	White bass	425FN1	66.4	371FN1	67.7	1.94
4	Smallmouth bass	436FN1	39.1	375FN1	41,3	5.47
3	Freshwater drum	447FN1	10.1	376FN1	9.5	6.02
1	White bass	450FN1	68.0	406FN1	68.4	0.59

Table 6-2. Interlaboratory Comparison of PFOS (ng/g, ww) in Fish Collected from Pool 2 and Analyzed by 3M and AXYS

Reach	Species	Field ID	3M Split	AXYS split	Relative Percent Difference
9	Bluegill	126	* == 21.6	37.4	1,14,6
· 10	Bluegill	22	305	356	4.4
	Freshwater drum	78	35.2	42.15	3
1	Freshwater drum	269	40.3	44.4	9.68
3	Freshwater drum	447	10.1	11.8	15 .5
4	Freshwater drum	258	7.07	9.33	27 .6
5	Freshwater drum	192	41.9	46.3	
- 6	Freshwater drum	170	28.6	29.3	12
6	Freshwater drum	323	14.6	17.5	
6	Freshwater drum	334	31.3	31.7	1,27
8	Freshwater drum	315	27	31.3	14.8
9	Freshwater drum	137	11.9	12.6	5.71
* 10	Freshwater drum	× 10	29.1	34	1 18.5
	Smallmouth bass	92 ·	13.5	15.6	4
1	Smallmouth bass	102	44.2	51.3	
2	Smallmouth bass	280	46.1	52.5	13
3	Smallmouth bass	54	30	34.3	13.4
3	Smallmouth bass	360	32.6	33.8	3(61
. 4	Smallmouth bass	224	23.5	31.1	27.8
4	Smallmouth bass	246	18.6	21.6	S STATE OF S
4	Smallmouth bass	. 436	39.1	43	44 19. 5 ⊮
5	Smallmouth bass	180	13.7	13.2	3.72
5	Smallmouth bass	203	41.9	61.9	38 .5
7	Smallmouth bass	291	42.3	44.6	5.29
7	Smallmouth bass	302	36.8	35.6 NF 4 NF 2	31 e
8	Smallmouth bass	383	40.1	51.5 mm m ²	17.9
9	Smallmouth bass	390	9.5	2 10.9 1 10.9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
10	Smallmouth bass	159	76.7	112	37.4
1	White bass	411	62.2	83.3	29
1	White bass	450	68 *****	80.6	
1. 112.	White bass		34.9	40	
+ Z	White bass White bass	** 370	00.3	75.5	
3	White bass	346	34.8	45.7 # ## ##	

Table 6-2. Interlaboratory Comparison of PFOS (ng/g, ww) in Fish Collected from Pool 2 and Analyzed by 3M and AXYS

PFOS

Reach	Species	Field ID	3M Split	AXYS split	Relative Percent Difference
4	White bass	232	64.7	79.4	20.4
5	White bass	400	56.7	66.9	16.5
6	White bass	214	73.4	89.1	19.3
7	White bass	113	45.3	59.5	27.1
**************************************	White bass	33	42.1	44.6	5.77
535, 8	White bass	45	59.5	75.3	23.4
9	White bass	149	71.4	88.6	21.5
9	White bass	425	66.4	65.2	1.82

Table 6-3. Interlaboratory Comparison of PFOS (ng/L) in Surface Water Collected from Pool 2 During Rounds 1 and 2 and Analyzed by 3M and AXYS

		AX	YS Lab	3M	Lab	
Reach	Field ID	PFOS	Qualifier ¹	-	Qualifier ¹	Relative Percent Difference
4. 1. S.	512	<1.98		< 2.00		A SC
1 .	513	< 2.50	U	< 2.00	U	NA NA
311	514	< 2.00	U V	< 2.00	The state of the s	NA NA
2	509	< 1.99	U	< 2.00	U	NA
2	510	< 2.00	U	< 2.00	U	NA
2	511	< 2.03	U	< 2.00	U	NA
* 3	506	< 1,99	Ų×	< 2.00	* A ***	NA PER HER
3	507	<1.95	Ü	< 2.00	U	NA NA
3	508	< 1.98	J. U.	× <2.00		**************************************
4	533	< 3.17	U	< 2.00	U	NA
4	534	< 6.62	U	< 2.00	U	NA
4	535	< 3.53	U	< 2.00	U	NA
5 5	5 30 -	9.17	an and a second	7.10	engg m ns type as an	25.4 Par # * Pres
5	531	<3.67	U.	< 2.00	u U	NA NA
5	_* 532	< 4.28	U	< 2.00	Ų.	NA
6	527	3.45	Sp. 11 181	2.60	到一张 ³⁵ 。	28.1
6	528	< 3.74	U	< 2.00	U	NA
6	529	< 3.53	U	< 2.00	U	NA
7	524	4.94	· · · · · · · · · · · · · · · · · · ·	2.77		56.3
7. **	525	< 4.94		< 2.00	wi U	NA
7 7	526	< 4.94	U	< 2.00	t ut o	NA NA
8	503	< 1.97	U	< 2.00	U	NA
8	504	< 2.48	U	< 2.00	U	NA
8	505	< 2.30	U	< 2.00	U	NA
9.	518	< 4,13	U	2.15	The second	NA NA STATE OF THE RESERVE OF THE RE
9 9	519	< 3.65	U.	< 2.00	U	NA NA
9.5	, 520 ₍₁₎	< 3.46	January Contraction	**************************************		NA NA
10	501	84.9		136		46.3
10	502	< 2.69	U	< 2.00	U	NA
10	515	4.96		4.20		16.6

¹ U = undetected

Bold italicized values indicate detected PFOS results

Table 6-4. Descriptive Statistics for PFOS (ng/g, wet weight) in Fish Collected from Pool 2 (2011) and Analyzed by 3M

ALL SAMPLES			Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
N of Cases Arithmetic Mean [PFOS]	100			
Standard Deviation	22	75	75	41
Maximum [PFOS]	392	209	757	394
100 mm	4	က	5	13
	18	000	30	
ספטוופוווג וויפטו [ררט].	20	28		286

Table 6-5. Descriptive Statistics for PFOS (ng/g, wet weight) in Fish Collected from Reach 1 of Pool 2 (2011) and Analyzed by 3M

REACH 1			Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White hass
FOS	0.	23		
Standard Deviation	2	59	15	
Maximum [PFOS]	11	213	56	9/
96 00 Miles	4	¥	ω	13
PFOSJ c Mean [PFOS]	9	33	77 20	56.

PFOS Results 6-9

Table 6-6. Descriptive Statistics for PFOS (ng/g, wet weight) in Fish Collected from Reach 2 of Pool 2 (2011) and Analyzed by 3M

REACH 2			Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
	n 12	01	10	10
	9	33		16
Maximum [PFOS]	27	26	52	89
Minimum [DEOS]	7	9	5	35
PFOSI	100	30	20	

Table 6-7. Descriptive Statistics for PFOS (ng/g, wet weight) in Fish Collected from Reach 3 of Pool 2 (2011) and Analyzed by 3M

REACH 3		S	Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
	20 20 9 20 20 20	36 55 55 9	9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	47
	59		28	* 44

Table 6-8. Descriptive Statistics for PFOS (ng/g, wet weight) in Fish Collected from Reach 4 of Pool 2 (2011) and Analyzed by 3M

	White bass		20	91	36	
Species	Smallmouth bass	n ander alle	6	44	19	38
	Freshwater drum	24	23	9/	~	14.
	Bluegill	01	20	99	10	92
REACH 4	Statistic	FOS	Standard Deviation	Maximum [PFOS]	Minimum [PFOS]	

Table 6-9. Descriptive Statistics for PFOS (ng/g, wet weight) in Fish Collected from Reach 5 of Pool 2 (2011) and Analyzed by 3M

REACH 5			Species	•
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
SOJ	25 × 10 × 10 × 10 × 10 × 10 × 10 × 10 × 1	01	000	
Standard Devration Maximum [PFOS]	16 56	91 316	10 46	30
Minimum [PFOS] Median [PFOS] Geometric Mean [PFOS]	34	10 38 44	14	

PFOS Results 6-11

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Table 6-10. Descriptive Statistics for PFOS (ng/g, wet weight) in Fish Collected from Reach 6 of Pool 2 (2011) and Analyzed by 3M

Bluegill Freshwater drum Smallmouth bass White bass 10 10 10 10 121 14 11 18 121 14 11 18 392 57 51 105 10 10 19 47 10 10 23 58 55 23 29 58	REACH 6			Species	
OSJ 31 10 10 10 10 10 10 10 10 10 10 10 10 10	Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
121 14 11 18 18 392 57 51 105 47 10 19 47 47 55 55 55 55 55 55 55 55 55 55 55 55 55		9	000	3	
392 57 51 105 10 10 19 47 52 29 58	**	12	14	11	18
10 10 19 47 58 52 52 52 52 52 52 52 52 52 52 52 52 52	Maximum [PFOS]	392	27	51	105
52 29 58		10	10		47
		25.	72		19

Table 6-11. Descriptive Statistics for PFOS (ng/g, wet weight) in Fish Collected from Reach 7 of Pool 2 (2011) and Analyzed by 3M

REACH 7			Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
		30		
Standard Deviation	ω	29		59
Maximum [PFOS]	21	105	48	139
Minimum (PEOS)	4	တ	7	36
		11	70	2 42
Geometric Mean IPFOSI» #####	* - 10 O			

Table 6-12. Descriptive Statistics for PFOS (ng/g, wet weight) in Fish Collected from Reach 8 of Pool 2 (2011) and Analyzed by 3M

REACH 8			Species	
Statis	Bluegill	Freshwater drum	Smallmouth bass	White bass
FOS	10	20	00	
Standard Deviation	9	17	13	
Maximum [PFOS]	78	62	09	7.1
	10	15	1	34
08]	12	36	27	200

Table 6-13. Descriptive Statistics for PFOS (ng/g, wet weight) in Fish Collected from Reach 9 of Pool 2 (2011) and Analyzed by 3M

REACH 9			Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
Nof Cases Arithmetic Mean [PFOS] Standard Deviation Maximum [PFOS] Minimum [PFOS] Median.[PFOS] Geometric Mean IPFOSI	33 31 32 22 33 33 33 34 35 35 35 35 35 35 35 35 35 35 35 35 35	10 37 64 64 215 5	10 10 35 7 7	
	00	Ol 45	16	62

PFOS Results 6-13

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Table 6-14. Descriptive Statistics for PFOS (ng/g, wet weight) in Fish Collected from Reach 10 of Pool 2 (2011) and Analyzed by 3M

Stic Stic	REACH 10			Species	
FOSI 10 10 10 10 10 10 10 10 10 10 10 10 10	Stafistic	Bluegill	Freshwater drum	Smallmouth bass	1
		70 103 305 5 5	10 114 607 26 48	10 135 222 222 757 35 35	103 105 394 41 41

Table 6-15. Correlations of PFOS with Species-Specific Fish Characteristics (ND=0)

	To the second second			* * * * * * * * * * * * * * * * * * *			
	White bass	0.2309	0.0527	96	0.2614	90	
				27 Life 300			
	ass			į			
	Smallmouth bass	0.0651	0.5196	100	0.0583	0,504°0	
	S			,	2 1 2F		
	E						
1	Freshwater drum	0.0023	0.0062	5	-0.0124	0.9028	
	Fres						
_							
	Bluegill	0.0254	0.0536	100	-0.1244	0.2198	
			Ξ "			A de la dela de	
		Speaman	p-value	c	Spearman r	p-value	
ומטוס ט- וסי ססוו פומנוסווס סי יי		SIPFOSI Market Market	Length vs [PFOS]		Spearman	Age vs [PFOS]	
מממ		Mass vs. [PFOS]	Length vs)		₽ V	

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Mississippi River Pool 2 PFC Assessment - Fish Tissues and Water - Summer 2011

Table 6-16. Summary of Average PFOS Concentrations (ng/L) in Water Collected from Pool 2 in Round 2 (August) and Analyzed by 3M

Average by Reach ²			1.00			1.00					1,53		25		2.17	
Results ¹	4. C.	<2.0	0.50		<2.0	<2.0	<2.0	7. 1 mm x x x x x x x x x x x x x x x x x		2.6	<2.0	<2.0	277 \$2.0	2	3.51	<2.0
Units	ng/L ng/L	ng/L	ng/L	1)60 1)60 1)60 1)60 1)60 1)60 1)60 1)60	ng/L	ng/L	ng/L	Notes that the second s		ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Detection limit	2 2 2	7 0	7 6	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	2	2	2			7	2	2	2	2	7	7
Lab ID	542SF1 543SF1 544SF1	539SF1	540SF1	536SFI 537SFI 538SFI	533SF1	534SF1	535SF1	530SFI 531SFI	532SFT	527SF1	528SF1	529SF1	524SF1 525SF7 526SF7	521SF1	522SF1	523SF1
Field ID	5428F 5438F 5448F	539SF	540SF 641SE		533SF	534SF		530SF 530SF 531SF	532SF	527SF	528SF		524SF 525SF 526SF	521SF	522SF	523SF
Reach		2 6	~ ~	E SARE RESE	4	4	4			9	9	9		· &	8	∞

Table 6-16. Summary of Average PFOS Concentrations (ng/L) in Water Collected from Pool 2 in Round 2 (August) and Analyzed by 3M

each	Field ID	Lab ID	Detection limit	SIIIO	Meaning	
			The second secon			
1	E18CE	** 518SE	3	ng/L	C Z	
	TOOLS					40,15
Rei F	519SF	519SF1	7	T/Bu	07	
					266	
电 *	520SF	520SF1				
	*	S. Morael		/00	4.2	
9	515SF	515SF1	7	1/g/L	ļ	
	!		c	/ou	<2.0	47.07
9	516SF	516SF1	7	<u>.</u> 0 1	<u>;</u>	
			c	1/00	136	
1	517SF	517SF1	7	11g/L	22	

1<2.0 ng/L = undetected sample

² Average values were calculated using ½ the detection limit for non-detect samples

Table 6-17. Post-Study Fish Tissue Samples analyzed for PFOS by the 3M Lab and AXYS

Sample Class	Tissue ID	Split 1 Lab ID (3M)	Split 1 Lab ID (3M) Split 2 Lab ID (AXYS)	Split 3 Lab ID (3M)	Split 4 Lab ID (AXY
is R	ì		1001	* * * * * * * * * * * * * * * * * * *	2001
	1	**************************************	1021	1022	1023
3M Fish Tissue Control	F qu				
SINE TOTAL COMPANY STATE OF THE	SRM 1947	1012	1013	1014	1015
NIST-SKM Lake Michigali Fish Tissue NICT CDM 1 2/2 Surging Fish Tissue	SRM 1946		5001		100
NICTORNAL COLOCULAR SERVICE STATES OF THE ST		**************************************	1005		1007
	W H	TOTE TO SECURE OF THE PARTY OF		1018 %	1019
4	323FN3	1024	1025	1026	1027
12.12.12.1					

Table 6-18. Summary of PFOS (ng/g, wet weight) in Post-Study Fish Tissue Samples Analyzed by the 3M Lab and AXYS

Sample Class	Split 1 Lab ID (3M)	PFOS	Split 3 Lab ID (3M)	PFOS	RPD	Split 2 Lab ID (AXYS)	PEOS	Split 4 Lab ID (AVVC)	Č	
- 51 - 950		CF C	YKY .		100 mg/m			Opin + Lab ID (AA 13	301	ארם
		2	r.	0.76	4,42	1001	<5.0		× 5 M3	
3M Fish Tissue Control	1020	0.61		0.59	3.03	1001		7000	ga.	
3N Fish Tische Control	A DOOR		The state of the s			/*	73.5	1023	4.95	ı
	1020	7/n.	980	0.69	4.25	1029	< 5.08	(4)	< 5.03	
NIST-SRM Lake Michigan Fish Tissue	1012	6 27	1014	E 23		**************************************			Jan	
	May 15 May 1	j	<u>r</u>	_	<u>.</u>	1013	5.76	1015	5.94	3.08
INISH-SKM Lake-Superior Hish lissue	1008	2.23	1010	2.24	0.37	7009	< 4 R4			
Pool 2 Fish	1004	÷	4006		ØX.		5 H	99 N ₁₉₆		# 1
	FO :	, #	0001	-	5.89	1005	48.8	1007	44.3	29.6
Pool 2 Fight	9101	87,70	1018	85.8	223		0.00			if63
	7007	, ?	1					80	9 7 .0	2 2
1001 2 1 131	1024	14.01	1026	14.8	5.68	1025	17.1	1027	16.7	
*Duplicate (1013-D) reported by AXYS - 6.68 ng/g PFOS	3.68 ng/g PFOS							1701	10.7	76.3
¹NIST-SRM 1947 value 5.90 ± 0.39										

²NIST-SRM 1946 value 2.19 ± 0.08

Bold font = PFOS not detected; detection limit provided

PFOS Results 6-17

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Table 6-19. Average PFOS (ng/g, wet weight) in Post-Study Fish Tissue Samples Analyzed by 3M and AXYS

	•		
Sample Class	3M	AXYS	Relative Percent Difference
3M Fish Tissue Control	120		
H K T	09.0	Q Q	
NIST-SRM Lake Michigan Fish Tissue ¹	6.	5.85	7.39
	224	9	
Pool 2 Fish	40.	466	12.8
Pool 2 Fish	* * ** 86.73 **	930	266 <u>8</u> 1 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
Pool 2 Fish	14.42	16.9	15.8

¹NIST-SRM 1947 value 5.90 ± 0.39

²NIST-SRM 1946 value 2.19 ± 0.08

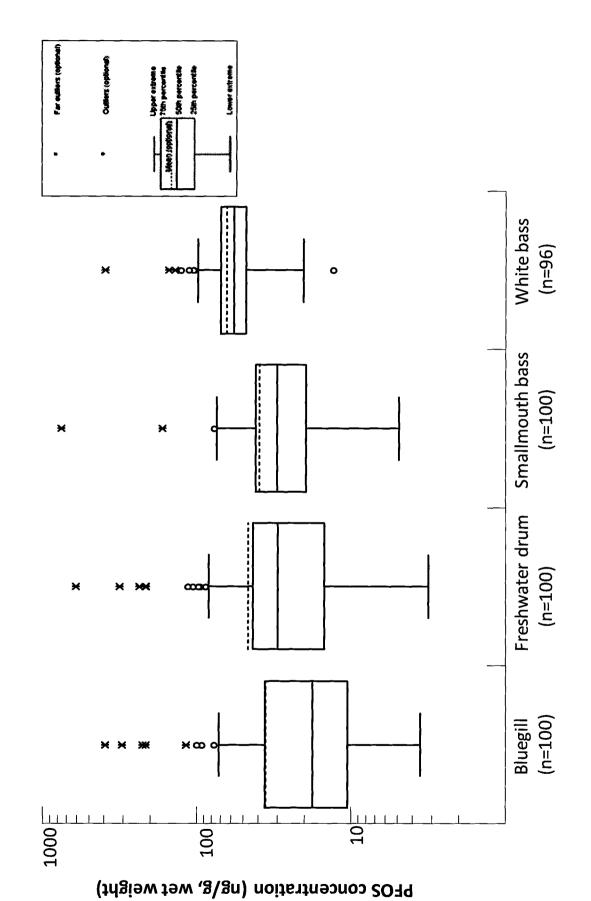
Bold font = PFOS not detected so average not calculated, DLs for non-detect samples ~ 5 ng/g, wet weight

Table 6-20. Relative Percent Difference (RPD) of Average PFOS Concentrations (ng/g, wet weight) in Post-Study Fish Tissue Samples Analyzed by 3M and AXYS

				PF0S1		
Cample Clace	Tissue ID	3M	AXYS	NIST Value	3M-NIST RPD	AXYS-NIST RPD
Sallipic Olass	ľ	And the second s	100	20 H		, va 0
gan Fish Tissue	SRM 1947	6.30	5.85	08.9°	4.00	
			5	2 10	2.15	1
NIST-SRM Lake Superior Fish Tissue	SKM 1946	7.74	2	2:10		

1Samples analyzed in duplicate, average result of duplicates is presented

Bold font = PFOS not detected so average not calculated



Mississippi River Pool 2 PFC Assessment – Fish Tissues and Water – Summer 2011

Figure 6-1. PFOS in Fish Tissues from Pool 2 (2011)

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n=10 per reach

Reach

Figure 6-2. PFOS in Fillet Tissues of Bluegill Collected from Pool 2 (2011)

Bluegill

1000 =

100 =

PFOS concentration (ng/g, wet weight)

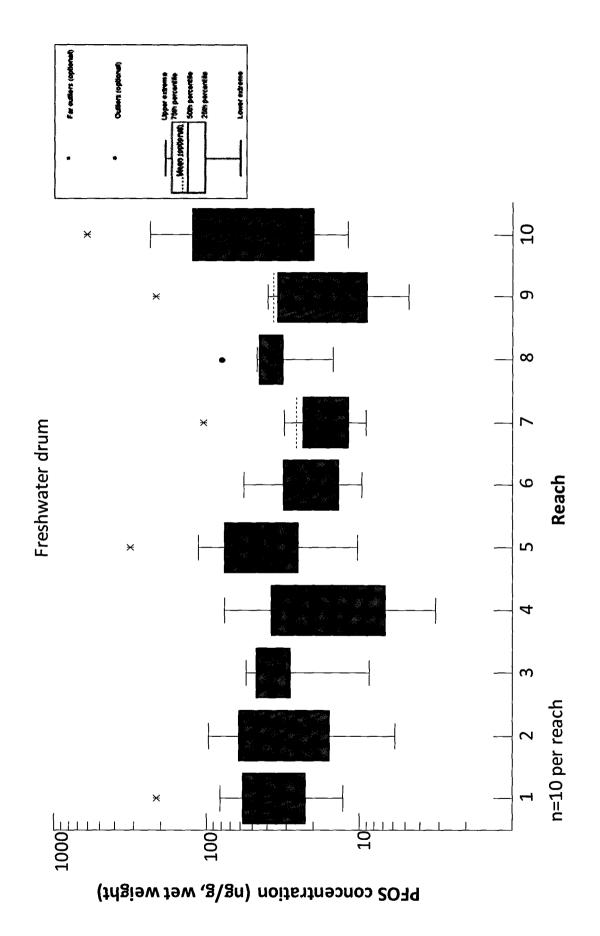
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OS Results

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Figure 6-3. PFOS in Fillet Tissues of Freshwater Drum Collected from Pool 2 (2011)

6

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9

Reach

n=10 per reach

Figure 6-4. PFOS in Fillet Tissues of Smallmouth Bass Collected from Pool 2 (2011)

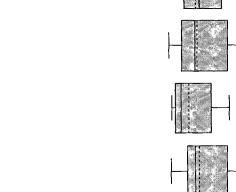
12

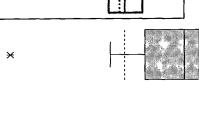
Nover.

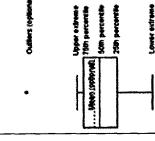
OS Results

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Smallmouth bass S \mathfrak{C} 1000E 100 PFOS concentration (ng/g, wet weight)









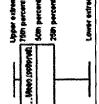














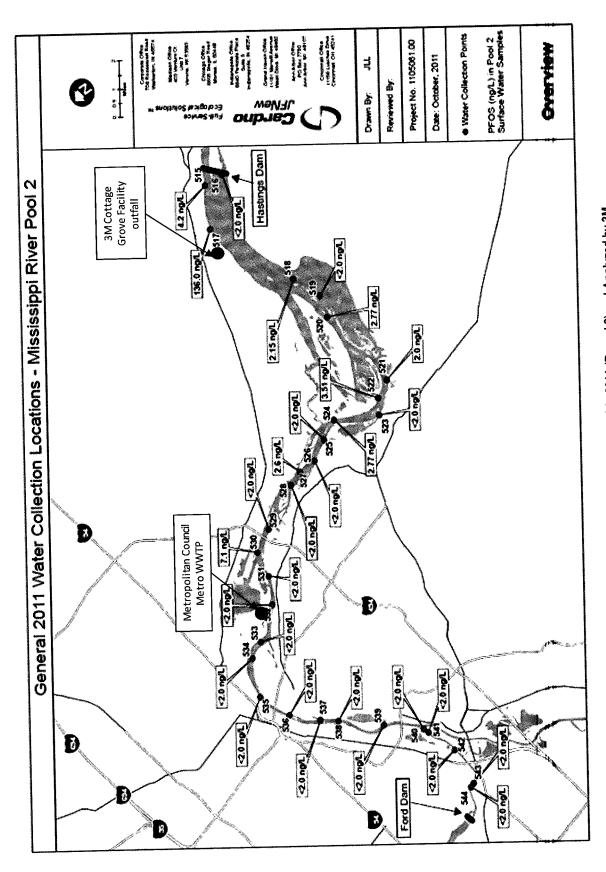






Figure 6-5. PFOS in Fillet Tissues of White Bass Collected from Pool 2 (2011)

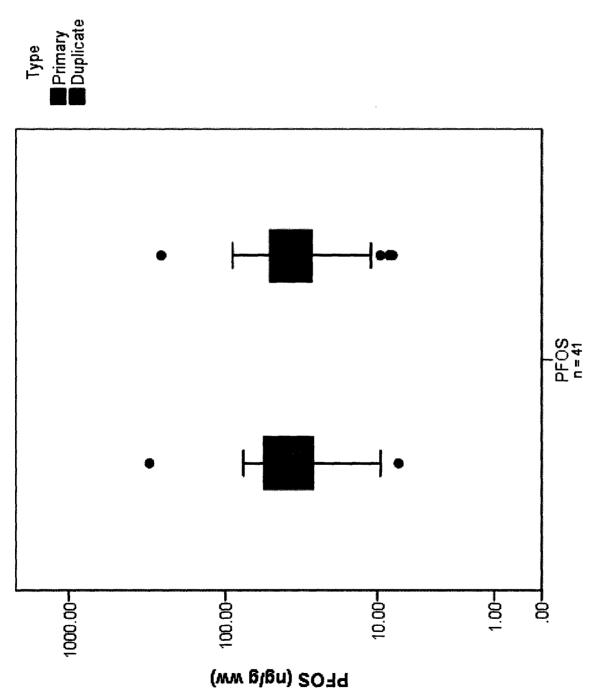
PFOS Results 6-23



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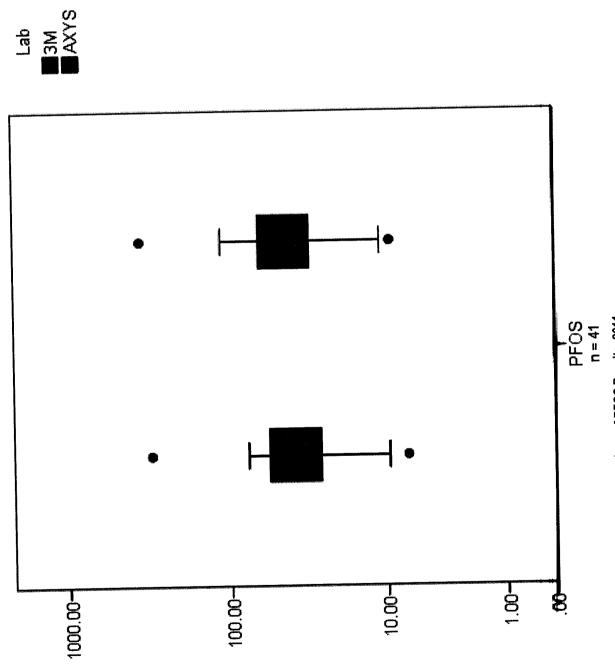
Figure 6-6. PFOS Concentrations (ng/L) in Surface Water Samples Collected from Pool 2 in 2011 (Round 2) and Analyzed by 3M

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Mississippi River Pool 2 PFC Assessment – Fish Tissues and Water – Summer 2011

Figure 6-7. Blind Duplicate Fish Tissue Comparison of PFOS Results (3M Lab Only), 2011



PFOS (ng/g ww)

Figure 6-8. Interlaboratory Fish Tissue Comparison of PFOS Results, 2011

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PFOS Results 6-27

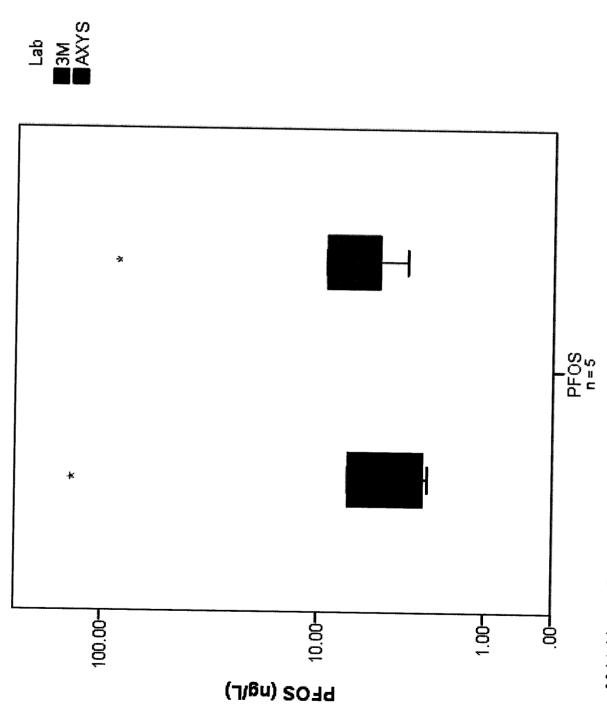


Figure 6-9. Interlaboratory Surface Water Comparison of PFOS Results, 2011

Chapter 7

Perfluorosulfonate Results

7.1 Intralaboratory Blind Duplicate Samples

Results from the analysis of fish tissue in both the primary and blind duplicate sample sets indicated good agreement for all perfluoroalkyl sulfonates (Table 7-1). PFBS was detected in 3 of 41 samples in both the primary and blind duplicate sample sets with concentrations ranging from 0.27 to 0.55 ng/g and 0.059 to 1.26 ng/g in the primary and blind duplicate sample sets, respectively. Of the 3 samples in both datasets, only 2 samples had matched IDs with an average fold difference of 1.7 and an average RPD of 92%. Taking into consideration the small sample size and low concentrations, a definitive evaluation of the data quality is not possible but appear to be of acceptable.

PFHS was detected in 14 of 41 samples in the primary sample set and 12 of 41 samples in the blind duplicate sample set. The concentration range in the primary dataset was 0.04 to 1.7 ng/g while it was 0.05 to 0.22 ng/g in the blind duplicate set. With one exception, there was less than a two-fold difference in measured concentrations with an average RPD of 19%. The exception was observed in one fish sample (Field ID 370) that had a 32-fold difference and a RPD of 188% in measured concentrations. This relatively large difference was due the primary sample having a measured concentration of 1.7 ng/g while in the blind duplicate it was 0.05 ng/g, a value that approaches the LOQ. Based on the results from the other 8 matched samples, this sample was considered to be an outlier and not indicative of the quality of the data for this analyte.

PFOSA was detected in all 41 samples in both the primary and blind duplicate sample sets with concentrations ranging from 0.09 to 8.54 ng/g and 0.09 to 9.37 ng/g, respectively. Fold differences between sample sets ranged from 0.18 to 1.3 with an average RPD of 7.7%. Overall, perfluoroalkyl sulfonate concentrations reported by 3M for both the primary and blind duplicate sample sets were in close agreement demonstrating the accuracy and precision of the data reported by the 3M lab.

7.2 Interlaboratory Comparison Samples

7.2.1 Fish Tissue

The interlaboratory comparison of PFBS, PFHS and PFOSA was limited in scope due to the large number of non-detects (Table 7-2). While the 3M laboratory reported PFBS concentrations in three of the 41 interlaboratory fish samples, all the samples analyzed by AXYS were reported as less than the LOQ. Likewise for PFHS, the 3M lab reported 14 of the 41 samples with measured concentrations while all of the samples analyzed by AXYS had concentrations less than the LOQ. As a result, an interlaboratory comparison was not conducted for these two analytes. PFOSA was detected in all 41 fish tissue samples by the 3M lab while AXYS measured concentrations in 4 fish samples. Based on the results for the 4 matched samples, PFOSA concentrations ranged from 1.74 to 8.54 ng/g and 2.54 to 13.0 ng/g as reported by the 3M lab and AXYS, respectively. PFOSA concentrations measured by AXYS were approximately 23% greater than those reported by the 3M lab with RPDs ranging from 21 to 42% with an average of 31%. Overall, while the average RPD was greater than 20%, there was good agreement between the analytical results given by both laboratories when compared to results typically observed in other interlaboratory studies.

7.2.2 Surface Water

The interlaboratory comparison for PFBS, PFHS, and PFOSA in the 30 water samples were limited by the predominance of non-detects associated with the data reported by both laboratories (Table 7-3). For PFBS, both laboratories reported measured concentrations in three matched surface water samples that ranged from 2.4 to 26 ng/L and 2.3 to 29 ng/L for the 3M Lab and AXYS, respectively. In general concentrations reported by 3M were 24% less than that reported by AXYS with an average RPD of 47%. PFHS was measured in only one matched surface water sample with a concentration of 12.5 and 6.3 ng/L reported by the 3M Lab and AXYS, respectively. The relative percent difference was 67%. PFOSA concentrations in all surface water samples analyzed by both laboratories had reported values that were less than the LOQ. As such comparison was not done for this analyte.

7.3 Study Fish Tissue Samples

Concentrations of PFBS in all fish samples collected from Pool 2 were dominated by non-detects (93%) and of the samples with measurable concentration, only a single sample was greater than 1.0 ng/g ww (Table 7-4). With non-detects set to half the LOQ, concentrations of PFBS in all fish ranged from 0.03 to 1.70 ng/g ww with an overall arithmetic mean, geometric mean and median of 0.6, 0.49, and 0.4 ng/g ww, respectively. Species-specific arithmetic means (95% confidence limit) were: bluegill 0.05 (0.04-0.07) ng/g ww, freshwater drum 0.09 (0.06-0.13) ng/g ww, smallmouth bass 0.06 (0.05-0.07) ng/g ww, and white bass 0.06 (0.05-0.07) ng/g ww (Table 7-5). Species-specific median PFBS concentrations were: bluegill 0.03 ng/g ww, freshwater drum 0.05 ng/g ww, smallmouth bass 0.05 ng/g ww and white bass 0.03 ng/g ww. Due to the large number of non-detects, the low measured PFBS concentrations, and variability observed in those measured values, no species-specific trend in PFBS concentrations was identified for fish collected in Pool 2. Likewise, when average PFBS concentrations for all fish by reach were compared, no discernible trend in PFBS concentration was observed in Pool 2. All PFBS concentrations as reported by 3M for each fish are provided in Appendix A, Table A-1.

PFHS concentrations in fish tissues were also dominated by the presence of non-detects, however the frequency of non-detects was species specific (Table 7-6). For instance, the number of samples with measured PFHS concentrations for bluegill, freshwater drum, smallmouth bass and white bass were 38, 31, 7 and 53, respectively. PFHS was detected in at least one sample from each reach for bluegill, freshwater drum, and white bass while for smallmouth bass, concentrations are only reported for Reaches 9 and 10. Concentrations of PFHS in all fish ranged from 0.01 to 22.9 ng/g ww with arithmetic mean, geometric mean and median of 0.17, 0.048 and 0.03 ng/g ww, respectively. Only one sample had a concentration greater than 10 ng/g ww. Species-specific arithmetic averages (95% confidence limits) for Pool 2 were: bluegill 0.42 (0.0-0.90) ng/g ww, freshwater drum 0.9 (0.04-0.14) ng/g ww, smallmouth bass 0.04 (0.03-0.05) ng/g ww, and white bass 0.12 (0.07-0.17) ng/g ww (Table 7-7). Species-specific median PFHS concentrations for bluegill, freshwater drum, smallmouth bass and white bass were 0.05, 0.03, 0.03, and 0.06 ng/g ww, respectively. The species-specific rank order, from least to greatest PFHS concentrations based on either arithmetic mean or median, was smallmouth bass, freshwater drum, white bass, and bluegill. With the exception of smallmouth bass, a comparison of species-specific average PFHS concentration by reach showed that reaches with the greatest concentrations tend to cluster into three groups, regardless of species (Table 7-6). The first cluster included Reaches 2 and 3, the second cluster consisted of Reach 6 and the third cluster included Reach 10. While the higher PFHS concentrations in Reach 6 and 10 are most likely are due to the presence of upriver PFC, the relatively great concentration observed for bluegill and white bass in Reaches 2 and 3 were unexpected and cannot be accounted for at this time. All PFHS concentrations as reported by 3M for each fish are provided in Appendix A, Table A-1.

Measured PFSOA concentrations were reported for 100% of the freshwater drum, smallmouth bass, and white bass samples while only 93% of the bluegill samples had measured concentrations (Table 7-8). PFOSA concentrations in all Pool 2 fish ranged from 0.1 to 31.5 ng/g ww with arithmetic mean, geometric mean and median of 0.67, 0.28 and 0.28 ng/g ww, respectively. Of the 396 samples that were analyzed, 60 samples had PFOSA concentrations greater 1 ng/g ww, 5 samples with concentrations greater than 5 ng/g ww and 2 samples with concentrations greater than 10 ng/g ww. Species-specific arithmetic mean (95% confidence limits) PFOSA concentrations were: bluegill 0.08 (0.07-0.10) ng/g ww, freshwater drum 0.33 (0.23-0.43) ng/g ww, smallmouth bass 0.97 (0.32-1.62) ng/g ww and white bass 1.31 (1.05-1.57) ng/g ww (Table 7-9). Species-specific median PFOSA concentrations were 0.07, 0.18, 0.40, and 0.92 ng/g ww for bluegill, freshwater drum, smallmouth bass and white bass respectively. The species rank order of PFOSA concentrations from least to greatest based on either mean or median values was bluegill, freshwater drum, smallmouth bass and white bass. In general, there was less than a 5-fold difference in mean PFOSA concentrations across all 10 reaches for all species (Table 7-8). However, the trend in PFOSA concentrations across all 10 reaches was not monotonic, rather it appeared to be biphasic with PFOSA concentrations being greatest in Reach 9-10 followed by Reaches 3 and 5 with concentrations between these two reach sets being less. All PFOSA concentrations as reported by 3M for each fish are provided in Appendix A, Table A-1.

Correlation analysis was conducted to evaluate the potential association between fish mass, length and age with fillet PFAS concentrations (Table 7-10). For PFBS, negative but statistically significant ($p \le 0.05$) correlations were observed between bluegill tissue concentrations and mass, length), and age; however, these associations were weak and accounted for less than 5% of the total variation. With the exception of age in freshwater drum, correlations coefficients between PFBS tissue concentrations and mass, length and age in freshwater drum, smallmouth bass and white bass were not statistically significant (p > 0.10). There was a statistically significant (p = 0.01) but weak negative association ($r^2 = 0.0677$) between PFBS concentration and age in freshwater drum. No statistically significant (p > 0.30) associations between PFHS tissue concentrations and mass, length, and age were observed for freshwater drum, smallmouth bass and white bass with typically coefficients of determination (r^2) generally being less than 0.0256. For bluegill, there was positive and statistically significant correlation with age and PFHS (p < 0.05) with approximately 15% of the total variation accounted by this association.

PFOSA fillet concentrations in bluegill were not significantly correlated (p > 0.20) to mass, length and age, these metrics were significantly correlated (p < 0.005) to PFOSA fillet concentrations in freshwater drum, smallmouth bass and white bass. For freshwater drum and smallmouth bass, there was a positive correlation between PFOSA concentrations and mass, length and age while for white bass there was a negative correlation between tissue concentrations and these metrics. Coefficients of determination (r^2) for freshwater drum, smallmouth bass, and white bass ranged from 0.0759 for age in bluegill up to 0.1804 for length in bluegill with an overall average r^2 of 0.1145. Overall the association between fish mass, length and age with PFAS tissue concentrations were weak with all associations accounting less than 30% of the total variation.

7.4 Study Surface Water Samples

In Round 2 (August), PFBS was measured in 3 of the 30 samples with all other samples having reported values less than the LOQ (Table 7-11). For PFHS, only one sample had a concentration greater than the LOQ while for PFOSA no water sample had a concentration greater than the LOQ. For surface water samples that had measurable concentrations, the greatest concentrations of PFBS (336 ng/L) and PFHS (61 ng/L) were observed at Station 517.

In Round 1 (June), the only detectable concentration of PFBS and PFHS were observed in surface water collected from Station 501 the same locations as Station 517 sampled in Round 2. In Round 1, water concentrations of PFBS and PFHS at Station 501 were 26 and 13 ng/L, respectively (Table 7-12). At Station 517, the Round 1 PFBS concentration was approximately 13-fold greater than Round 2 while for PFHS it was approximately 1.8-fold less. The basis for these differences is unknown but most likely due to multiple factors including changes in river water levels as well as changes in discharge concentrations from sources to the river.

7.5 Tables and Figures

Table 7-1. Intralaboratory Blind Duplicate Comparison of Perfluorosulfonate Concentrations (ng/g, wet weight) in Fish Collected from Pool 2 and Analyzed by 3M (2011)

			Allalyzed by SW (2	,	Relative Per	rcent Difference	(RPD, %)
Reach	Species	Field ID	Primary Lab ID	Duplicate Lab ID	PFBS	PFHS	PFOSA
10	Bluegill	022	022FN	019FN1	* I II	15.5	11.7
9 *	Bluegill	126	126FN ***	105FN1	e green	9.98	8.68
10	Freshwater drum	010	010FN	012FN1			0.59
1	Freshwater drum	078	078FN	073FN1	ग्रह्मः ^{त्य} श्रीतरक्ष्याचा क्र	8.01	0.89
9	Freshwater drum	137	137FN	121FN1			5.08
6	Freshwater drum	170	170FN	147FN1			2.16
5	Freshwater drum	192	192FN	173FN1			1.61
. 4 1.	Freshwater drum	258	258FN	228FN1			21.0
1	Freshwater drum	269	269FN	233FN1	e e e e e e	* ************************************	9.34
8	Freshwater drum	315	315FN	265FN1	9975*		1.92
6	Freshwater drum	323	323FN	275FN1			10.7
6	Freshwater drum	334	334FN	284FN1			4.30
3	Freshwater drum	447 A	447FN	376FN1	102	"Tarkelly," Shelle	24.9
3	Smallmouth bass	054	054FN	060FN1			0.46
	Smallmouth bass	092	092FN	077FN1			8.27
1	Smallmouth bass	102	102FN	089FN1	remedia) "The relation	201 18	5.47
10	Smallmouth bass	159	159FN	139FN1			9.31
5	Smallmouth bass	180	180FN	169FN1	81.9		2.01
5	Smallmouth bass	203	203FN	182FN1	er) 4 Mass	·KE. 4	15.4
4	Smallmouth bass	224	224FN	196FN1	\$ · **		17,5
4	Smallmouth bass	246	246FN	225FN1			3.31
2	Smallmouth bass	280	280FN	244FN1	Newton	527	4.18
7	Smallmouth bass	291	291FN	245FN1			28.0
7	Smallmouth bass	302	302FN	255FN1			18.7
3 **	Smallmouth bass	360	360FN	324FN1			3.03
8	Smallmouth bass	383	383FN **-	339FN1		1 1 2 1 2	× 6.34
9	Smallmouth bass	390	390FN	347FN1	e e e e e e e e e e e e e e e e e e e		2.32
4	Smallmouth bass	436	436FN	375FN1			4.68
8	White bass	033	033FN	042FN1			5.66
8	White bass	045	045FN	043FN1		45.9	4.16
2	White bass	065	065FN	068FN1	A THE RESIDENCE OF THE PERSON	2.48	7.89
7.1	White bass	113	113FN	090FN1 122FN1	* * * * * * * * * * * * * * * * * * *	10.2	2.66
9 .		14 9	149FN	122FN1	***	43.8	0.04

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Table 7-1. Intralaboratory Blind Duplicate Comparison of Perfluorosulfonate Concentrations (ng/g, wet weight) in Fish Collected from Pool 2 and Analyzed by 3M (2011)

Reach	Species	Field ID	Primary Lab ID	Duplicate Lab ID	PFBS	PFHS	PFOSA
6	White bass	214	214FN	184FN1		. —	16.7
4	White bass	232	232FN	210FN1			3.83
3	White bass	346	346FN	314FN1			15.6
. 2	White bass	370	370FN	327FN1	# # # # # # #	188	9.25
.5	White bass	100	400FN	348FN1			2,47
1	White bass	411	411FN 💀	357FN1	T T T T T T T T T T T T T T T T T T T		5.63
9	White bass	425	425FN	371FN1			8.05
1	White bass	450	450FN	406FN1		18.0	2.40

All reported RPD values were for samples that had paired results greater than the LOQ

Table 7-2. Interlaboratory Comparison of Perfluorosulfonate Concentrations (ng/g, wet weight) in Fish Collected From Pool 2 and Analyzed by 3M and AXYS (2011)

				_	Relative Pe	ercent Dinerenc	e (KFD, 70)
Reach	Species	Field ID	3M Lab ID	AXYS Lab ID	PFBS	PFHS	PFOSA
10	Bluegill	022	022FN	019FN1			
9	Bluegill	126	126FN	. 105FN1	7 2 2 2 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3		
10	Freshwater drum	010	010FN	012FN1			
1	Freshwater drum	078	078FN	073FN1		A VAAA MARKE AAA	A RAMINI SAL
9	Freshwater drum	137	137FN	121FN1			
6	Freshwater drum	170	170FN	147FN1			
5	Freshwater drum	192	192FN	173FN1			
4	Freshwater drum	258	258FN	228FN1			
* *** ********************************	Freshwater drum	269	269FN	233FN1	20 AC H2 AC 48 AC		
8	Freshwater drum	315	315FN	265FN1			
6	Freshwater drum	323	323FN	275FN1			
6	Freshwater drum	334	334FN	284FN1	W 000 100000		
**************************************	Freshwater drum	447	447FN	376FN1			
3	Smallmouth bass	054	054FN	060FN1			
· 1	Smallmouth bass	092	.092FN	077FN1	(* 14 E - 1 _{2 S}		
1	Smallmouth bass	102	102FN	089FN1			
10	Smallmouth bass	159	159FN	139FN1			42
5	Smallmouth bass	180	180FN	169FN1			
5	Smallmouth bass	203	203FN	182FN1		L. Paragran	n state.
4	Smallmouth bass	224	224FN	196FN1			
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Smallmouth bass	246	246FN	225FN1			
2	Smallmouth bass	280	280FN	244FN1			
7	Smallmouth bass	291	291FN	245FN1			
7	Smallmouth bass	302	302FN	255FN1	10.9 P. J		
3 €	Smallmouth bass	360	360FN	324FN1	- Járá		181 181 ¹⁹⁸ 181
8	Smallmouth bass	#383 ## Sel	383FN	339FN1	Alta Alta.	water and the	
, 9	Smallmouth bass	390	390FN	347FN1	* 10 × 11 × 1	147.2 2.3 1.4	AR II
4	Smallmouth bass	436	436FN	375FN1			
8	White bass	033	033FN	042FN1			
8	White bass	045	045FN	043FN1		West Control	21.4
2	White bass	065	065FN	068FN1	n gantajeta neika P nazdane naser		
: . 7	Milita basa	113	113FN	090FN1			
9	White bass	149	149FN	122FN1			
6	White bass	214	214FN	184FN1			
4	White bass	232	232FN	210FN1			
3	White bass	346	346FN	314FN1			

Table 7-2. Interlaboratory Comparison of Perfluorosulfonate Concentrations (ng/g, wet weight) in Fish Collected From Pool 2 and Analyzed by 3M and AXYS (2011)

Daaah	Cuasias	Eivid ID	3M Lab ID	AXYS Lab ID	PFBS	PFHS	DEOCA
Reach	Species	Field ID	3M Lab ID	AX 19 Lab ID			PFOSA
2.	White bass	370	370FN	327FN1	42 900 + 134 400 350 -		
5	White bass	400		348FN1			23.4
. 1	White bass	411	411FN	357FN1			
9	White bass	425	425FN	371FN1			
1	White bass	450	450FN	406FN1			37.1

All reported RPD values were for samples that had paired results greater than the LOQ

Table 7-3. Interlaboratory Comparison of Perfluorosulfonate Concentrations (ng/L) in Surface Water Collected from Pool 2 During Rounds 1 and 2 and Analyzed by 3M and AXYS (2011)

				Relative	Percent Difference (RPI), %)
Reach	Field ID	3M Lab ID	AXYS Lab ID	PFBS	PFHS	PFOSA
	512	512SF1	512SF2			
	513	513SF1	513SF2	THE STATE OF	· 加州公司(1985年) - 1986年 1986年	Hart of H
. 1 ~	514	514SF1	514SF2	**	大利服 1	の
2	509	509SF1	509SF2			
2	510	510SF1	510SF2			
2	511	511SF1	511SF2			
3	506	506SF1	506SF2	# F	輸 級 R	e ^P N B
3	507	507SF1	507SF2		5 B + F = 1	
3 - 1 h	508	508SF1	508SF2			
4	533	533SF1	533SF2		er in our comment	36 VAL 95 ARCHIT - 12**
4	534	534SF1	534SF2			
4	535	535SF1	535SF2			
5	530	530SF1	530SF2	47.4		
5	4531 · ***********************************	#531SF1	531SF2			
5	532	532SF1	532SF2			超 銀 次
6	527	527SF1	527SF2			
6	528	528SF1	528SF2			
6	529	529SF1	529SF2			
***** 7 ,	524	524SF1	524SF2	A Sales Sale	新 ロ ²⁰	34 週間衛星型30 888出
. e 7	525	525SF1	525SF2			
7	526	526SF1	526SF2			
8	503	503SF1	503SF2			
8	504	504SF1	504SF2			
8	505	505SF1	505SF2			
9 -	518	518SF1	518SF2		24 E	
9 *	519	519SF1	519SF2			
***************************************	520	520SF1	520SF2			THE CONSTRUCTOR OF THE CONSTRUCT
10	501	501SF1	501SF2	31.1	66.7	
10	502	502SF1	502SF2			
10	515	515SF1	515SF2	61.4		

All reported RPD values were for samples that had paired results greater than the LOQ

Table 7-4. Descriptive Statistics for PFBS (ng/g, wet weight) in Fish Collected From Pool 2 and Analyzed by 3M (2011)

ALL SAMPLES		3	Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
Arithmetic Mean [PFBS]	90'0	1000 m s 100	9000	900
Number of Detects	2.5	8		
Number of Non-detects	6		26	88 x x x x x x x x x x x x x x x x x x
Number of Samples Not Reported	2	က	9	5
Maximum [PFBS]	0.46	1.70	0.13	0.19
Minimum [PFBS]	0.03	0.03	0.03	0.03
Median PFBS	70:00	900		2000
Geometric Mean [PFBS]	0.04	0.06	900	900
	0			

1/2 RL was used as a proxy value for all non-detects

Table 7-5. Mean and 95% Confidence Intervals for PFBS Concentrations (ng/g, wet weight) in All Fish Collected in Pool 2 by Reach (2011)

Species Statistic	itic 1	2	က	4	2	9	7	∞	6	9
Bluegille as 95%	1000 L	200	10,03	1	0,042	0.072	1172	7000	86,468	0.051
Mean	0.042	0.112	0.12	0.05	0.031	0.051	0.051	0.242	0.111	0.131
Freshwater drum 95% CI	ر ت	1	[0.03, 0.21]	ı	1			•		1
	Aean 0.031	120'0	0.031	1900	000	•	0.092	70.0	19000	Ö
95% (10 10 10 10 10 10 10 10 10 10 10 10 10 1			s _e t _e		ä		i i	k 44 Mag
Mean	0.0			0.031	_	0.091	0.071	0.081	0.081	0.10
Write bass 95% CI		1	1	1	•	•	•	1	•	-

¹ All samples < LOQ; only mean DL reported

² Sample size ≤ 2; only mean reported

Table 7-6. Descriptive Statistics for PFHS (ng/g, wet weight) in Fish Collected From Pool 2 and Analyzed by 3M (2011)

ALL SAMPLES	1.1.4	6	Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
Arithmetic Mean [PFHS] Number of Detects Number of Non-etects	0.42 38 62	90.09	0.04	53 43
Number of Samples Not Reported	0	0	0	0
Maximum [PFHS]	22.89	2.45	0.26	1.70
Minimum [PFHS]	0.01	0.03	0.01	0.01
Median PFHS Geometric Mean PFHS Standard Deviation	0.05	0.03	0.03	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0

1/2 RL was used as a proxy value for all non-detects

Table 7-7. Mean and 95% Confidence Intervals for PFHS Concentrations (ng/g, wet weight) in Fish Collected in Pool 2 by Reach (2011)

			;			Reach	당				
Species	Statistic	-	2	8	4	ĸ	9	7	80	6	10
Ili6enig	Mean	00 5	0.1		0.132	0.08	106	0,092	0.042	2/00/0	0.052
Sizes	Mean	0.13	20.0 0.05	[-2.04, 7.52] 0.04	0.10	0.06	[-0.89] 3:01 0.06 ²	0.042	. 8	0.042	0.33
rresnwater ofum	95% CI	95% CI [0.02, 0.24]	[0.02, 0.08]	[0.03, 0.04]	[-0.05, 0.24]	[0.02, 0.10]	•	1	•		1-0.21, 0.871
allmouth bass	Mean	0.021	000	0.021	-	0.04	0.031	0.08	E00	0,032	9000
	Mean	0.05			161	0.05	Į.	0.12	0.0	90.0	B
Wille Dass	95% CI	95% CI [0.01, 0.08] [-0.07, 0.7	[-0.07, 0.74]	[0.02, 0.05]	ı	[0.03, 0.07]	[0.07, 0.26]	[0.04, 0.20]	[0.03, 0.10]	[0.03, 0.10]	[-0.07, 0.50]
14 00 7 2 2 4	1	7									

1 All samples < LOQ; only mean DL reported

² Sample size ≤ 2; only mean reported

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Table 7-8. Descriptive Statistics for PFOSA (ng/g, wet weight) in Fish Collected From Pool 2 and Analyzed by 3M (2011)

ALL SAMPLES		de	Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
Arithmetic Mean [PFOSA]	800	033	260	
Number of Detects	T. CO.	2	00	96
Number of Non-detects				
Number of Samples Not Reported	0	0	0	0
Maximum [PFOSA]	0.49	2.97	31.45	10.40
Minimum [PFOSA]	0.01	0.05	0.12	0.34
Median [PFOSA] Geometric Mean [PFOSA]	2000	2 1 1 2 2 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3	0,00	0.02
Standard Deviation	0.07	10 T	328	
11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				

1/2 RL was used as a proxy value for all non-detects

Table 7-9. Mean and 95% Confidence Intervals for PFOSA Concentration (ng/g, wet weight) in Fish Collected in Pool 2 by Reach (2011)

						Re	Reach				
Species	Statistic	-	2	8	4	5	9	7	œ	6	10
in the second se	Wean New	0.05	0.07		0,06 m	0.09	180 U W	0.05 In n3.0 na	0.06	0.05 0.06 0.09 0.06 0.05 0.05 0.06 0.09 0.09 0.09 0.05 0.05 0.00 0.09	0.78
	Mean			0.19	0.18	0.29	0.14	0.24	0.15	0.44	
Freshwater drum	95% CI	95% CI [0.07, 0.34]	[-0.14, 0.75]	[0.12, 0.26]	[0.11, 0.26]	[0.16, 0.42]	[0.09, 0.19]	[0.16, 0.42] [0.09, 0.19] [0.19, 0.29]	[0.12, 0.17]	[0.27, 0.60]	[0.44, 1.90]
	Mean	\$0	0.2	0.37	69.0	0.46	0,40	0.38	0.25	20	
Smallmouth bass	D %96		[0.21, 0.30]	[0.27, 0.47] [0.50, 0.67]	[0.50, 0.67]	[0.39, 0.54]	[0.39, 0.54] [0.34, 0.45]	3195	[0,23, 0,54] [0,18, 0,33]	[0,18] 0.33] [0.34, 0.79] [-0.60, 12.70]	[-0.60, 12.70]
Surphy I	Mean	96'0	1.04	99:0	1.42	1.70	0.79		1.26	1.07	2.53
White bass	95% CI	[0.28, 1.65]	[0.28, 1.65] [0.71, 1.37]	[0.50, 0.82]	[0.43, 2.41]	[1.13, 2.28]	[0.65, 0.92]	[0.80, 2.24]	[0.53, 1.98]	[0.50, 0.82] [0.43, 2.41] [1.13, 2.28] [0.65, 0.92] [0.80, 2.24] [0.53, 1.98] [0.72, 1.43]	[0.43, 4.63]

1 All samples < LOQ; only mean DL reported

² Sample size ≤ 2; only mean reported

Cardno EN

Table 7-10. Correlations of Perfluorosulfonate Concentrations with Species Specific Fish Characteristics (ND=0)

3	į	Bluegill		Ē	Freshwater drum	Ę	S	Smallmouth bass	SSI		White bass	10
ပ	PFBS	PFHS	PFOSA	PFBS	PFHS	PFOSA	PFBS	PFHS	PFOSA	PFBS	PFHS	PFOSA
E	-0.1984	-0.1159	0.0708	-0,1697	0.0136	0.3984	_ 0.0917	0.0386	0.3286	-0,1593	0,0561	-0.3710
	ue 0.0502	0,2510	0.4838	0.0966	0,8933	< 0,0001	0.3792	0.7027	<0.0008	0.1338	0.5890	0.002
į	86	400	100	97	100	100	8	8	400	8	8	62
Spearman r	-0.200	-0.0620	0.0441	-01721	0.0781	0.42427	0.1282	0.0418	0.3257	-0.1611	0.1034	-0.3193
p-value	0.0483	0.5403	0.6628	0.0918	0.4399	< 0.0001	0.2183	0.6800	0.0000	0.1272	0.3162	0.0015
	86	100	100	26	100	100	94	100	100	91	96	96
lg l	n -0.2137	0.3906	-0,1278	-0,2601	0.0447	0,2755	0.0997	0.0508	03171	-0.1662	0.0612	-0.3462
	0.0356	<0.0001	0.2076	0.00	0.6586	0,0055	0.3391	0.6159	0.0013	0.1154	0.5337	nnna
B _{ie}	. 46	• 0 0		- 6	180		Č	Bara non				
	ž	100 miles	, CO	20.	E LOW E	3	±S.	20	3	7 2	S	8

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Table 7-11. 3M Analysis of Round 2 (August) Surface Water Samples for Perfluorosulfonates (ND=RL)

Field ID	Tissue ID	Lab ID	Reach	Start Northing	Start Westing	PFBS	PFHS	PFOS	PFOSA
. 515 · · ·	515SF	515SF1	. 10.	N44° 46.018'	W92° 52.305'	2,37	< 2.0	4.2	< 2.0
516	516SF	516SF1	10	N44° 45.382'	W92° 52.521'	< 2.0	< 2.0	< 2.0	<2.0
517	517SF	517SF1	10	N44° 46.926′	W92° 53.313'	336	60.5	136	< 2.0
518	518SF	518SF1	9	N44° 46.207'	W92° 56.501'	< 2.0	< 2.0	2.15	< 2.0
519	519SF	519SF1	9	N44° 45.987'	W92° 57.531'	< 2.0	< 2.0	< 2.0	< 2.0
520	520SF	520SF1	9	N44° 46.333'	W92° 58.151'	< 2.0	< 2.0	2.77	< 2.0
521	521SF	521SF1	8	N44° 46.444'	W93° 00.988'	< 2. 0	< 2.0	- ^{3/} 2	< 2.0
522	522SF	522SF1	8	N44° 47.081'	W93° 01.130	< 2.0	< 2.0	3.51	< 2.0
523	523SF	523SF1	8 * *	N44° 47,463'	W93° 01.516'	≤ 2.0	< 2.0	< 2.0	< 2.0
524	524SF	524SF1	7	N44° 48.609'	W93° 00.424'	< 2.0	< 2.0	2.77	< 2.0
525	525SF	525SF1	7	N44° 49.305'	W93° 00.573'	< 2.0	< 2.0	< 2.0	< 2.0
526	526SF	526SF1	7	N44° 50.012'	W93° 00.740′	< 2.0	< 2.0	< 2.0	< 2.0
527 .	527SF	527SF1	6	N44° 50,602'	W93° 00.576'	< 2.0	≤2.0	2.6	< 2.0
528	528SF	528SF1	6	N44° 51.126'	W93° 00.620'	< 2.0	< 2.0	< 2.0	< 2.0
529	529SF	529SF1	6	N44° 52.673'	W93° 00.927'	< 2.0	< 2.0	< 2.0	<u></u> \$2.0
530	530SF	530SF1	5	N44° 53.478'	W93° 01.101'	4.17	< 2.0	7.1	< 2.0
531	531SF	531SF1	5	N44° 53.772'	W93° 01.866'	< 2.0	< 2.0	< 2.0	< 2.0
532	532SF	532SF1	5	N44° 54.371'	W93° 02.547'	< 2.0	< 2.0	< 2.0	< 2.0
533	533SF	533SF1	4 4 4 4 4 5 6	N44° 55.507'	W93° 03.004′	< 2.0	< 2.0	< 2.0	<2.0
534	534SF	534SF1	4 .	N44° 56,082'	W93° 03.129'	< 2.0	< 2.0	< 2.0	< 2.0
535	535SF	535SF1	4	N44° 56.830'	W93° 04.115'	< 2.0	< 2.0	< 2.0	2.0
536	536SF	536SF1	3	N44° 56.586'	W93° 05.248'	< 2.0	< 2.0	< 2.0	< 2.0
537	537SF	537SF1	3	N44° 56.006'	W93° 06.160'	< 2.0	< 2.0	< 2.0	< 2.0
538	538SF	538SF1	3	N44° 55.616'	W93° 06.650'	< 2.0	< 2.0	< 2.0	< 2.0
539	539SF	539SF1	2	N44° 54.672'	W93° 07.920'	< 2.0	< 2.0	< 2.0	< 2.0
540	540SF	540SF1	2	N44° 53.865'	W93° 09.056'	< 2.0	< 2.0	< 2.0	< 2.0
541	541SF	541SF1	2	N44° 53.827'	W93° 09.236'	√ < 2.0 "	< 2.0	< 2.0	< 2.0
542	542SF	542SF1	1	N44° 53.637'	W93° 10.279'	< 2.0	< 2.0	< 2.0	< 2.0
543	543SF	543SF1	1	N44° 53.995'	W93° 11.442'	< 2.0	< 2.0	< 2.0	< 2.0
544	544SF	544SF1	1	N44° 54.140'	W93° 11.461'	< 2.0	< 2.0	< 2.0	< 2.0

RL was used as a proxy value for all non-detects

Bold, italicized text = Detects

Table 7-12. 3M Analysis of Round 1 (June) Surface Water Samples for Perfluorosulfonates (ND=RL)

Field ID	Tissue ID	Lab ID	Reach	Start Northing	Start Westing	PFBS	PFHS	PFOS	PFOSA
501	501SF	501SF1	10	N44° 46.926'	W92° 53.313'	26	12.5	136	< 4.0
502	502SF	502SF1	4, 10	N44° 45,382'	W92° 52.521'	< 2.0	< 2.0	< 2.0	<4.0
503	503SF	503SF1	8	N44° 47,471'	W93° 01.521'	₹2.0	< 2.0	< 2.0	< 4.0 →
504	504SF	504SF1	8	N44° 47.086'	W93° 01.118'	< 2.0	< 2.0	< 2.0	< 4.0
505	505SF	505SF1	8	N44° 46.447'	W93° 00.999'	< 2.5	< 2.0	< 2.0	< 2.0
506	506SF	506SF1	3	N44° 56.048′	W93° 06.085'	< 2.0	< 2.0	< 2.0	< 4.0
507	507SF	507SF1	. 3	N44° 56.589'	W93° 05.240'	< 2.0	≤ 2.0	< 2.0	4.0
508	508SF	508SF1	3	N44° 55,611'	W93° 06.663'	< 2.0	< 2.0	< 2.0	<4.0
509	509SF	509\$F1	2	N44° 53.823'	W93° 09.231'	< 2.0	< 2.0	< 2.0	< 4.0
510	510SF	510SF1	2	N44° 53.865'	W93° 09.064'	< 2.0	< 2.0	< 2.0	< 4.0
511	511SF	511SF1	2	N44° 54.699'	W93° 07.907'	< 2.0	< 2.0	< 2.0	< 4.0
512	512SF	512SF1	1	N44° 54.149'	W93° 11.459'	< 2.0	< 2.0	< 2.0	< 4.0
513	513SF	513SF1	h. 1	N44° 54.001'	W93° 11.443'	<2.0	< 2.0	< 2.0	< 4.0
514	514SF	514SF1	1 1	N44° 53.636'	W93° 10.274'	(< 2.0	< 2.0	< 2.0	< 4.0

RL was used as a proxy value for all non-detects

Bold, italicized text = Detects

Perfluorocarboxylate Results

8.1 Intralaboratory Blind Duplicate Samples

The comparison of analytical results for perfluorocarboxylic acids in fish tissue indicated good agreement between the primary and blind duplicate sample sets (Table 8-1). However, due to the large number of non-detects observed in both datasets, the evaluation of C4 to C8 PFCAs was limited. For instance, while PFPeA was detected in 4 samples in both the primary and blind duplicate samples sets, no matched samples were available for conducting the analysis. Likewise, no matched samples were available for PFHxA. For PFBA, 2 matched samples had measured concentrations that ranged from 0.12 to 1.3 ng/g and 0.21 to 2.4 ng/g with an average RPD of 20% in the primary and duplicate sample sets, respectively. For PFHpA, only 1 matched sample reported measured concentrations a RPD of 0.98%. Finally, only 1 matched sample had measured concentrations with a fold difference of 1.03 and a RPD of 2.9%. Regardless of the limited sample size, the measured concentrations of these PFCAs demonstrated that there was good agreement between the two sample sets with RPD value generally ≤ 20%.

The frequency of samples with measured concentrations was greater for PFCAs with carbon chains greater than 8. For PFNA, 21 matched samples reported measured concentrations that ranged from 0.03 to 0.8 ng/g ww in the primary dataset and 0.05 to 0.15 ng/g ww in the duplicate dataset. The average fold difference and RPD was 1.02 and 11%, respectively.

All 41 samples in both the primary and duplicate datasets had PFDA concentrations greater than the LOQ. PFDA concentrations in the primary dataset ranged from 0.48 to 11 ng/g www and from 0.59 to 9.3 ng/g in the duplicate dataset. Likewise, all 41 samples in both the primary and duplicate sample had measured PFUnA concentrations that ranged from 0.47 to 6.3 ng/g and 0.44 to 5.24 ng/g, respectively. For PFDoA, all 41 samples in both the primary and duplicate sample sets had concentrations greater than the LOQ that ranged from 0.25 to 4.75 ng/g and 0.25 to 4.41 ng/g, respectively. The average fold difference between both sample sets for PFDA, PFUnA and PFDoA were 1.03, 1.02 and 1.02, respectively. The average RPD values for PFDA, PFUnA and PFDoA were 13%, 10% and 9.9%, respectively that indicated good agreement between the both datasets.

8.2 Interlaboratory Comparison Samples

8.2.1 Fish Tissue

Due to the large number of non-detects reported by one or both laboratories, the interlaboratory comparison of PFCAs in the fish tissue could not be conducted (Table 8-2). This resulted in no matched samples where both laboratories reported concentrations of PFBA, PFPeA, PFHxA, PFHpA, PFOA, and PFNA that were above the LOQ of each analyte. As such, a comparison of analytical results for these analytes was not conducted.

PFDA was detected in all 41 fish samples by the 3M lab but was only detected in 14 samples by AXYS. Based on the 14 matched samples, PFDA concentrations ranged from 2.1 to 11 ng/g ww and 2.3 and 11 ng/g ww for the 3M and AXYS laboratories, respectively. PFDA concentrations reported

by the 3M Lab were slightly greater with an average RPD of 11%. PFDoA was also detected in all 41 fish samples by the 3M lab but was only detected in 3 samples by the AXYS. Based on the matched samples, measured PFDoA concentrations in fish ranged from 2.7 to 4.8 ng/g and 3.1 to 4.5 ng/g for the 3M Lab and AXYS, respectively. The average fold-difference between laboratories was 0.98 with an average RPD of 6.91%. For PFUnA, 3M reported measured concentrations for all 41 interlaboratory fish samples while AXYS reported measured concentrations for 4 samples. Based on the 4 matched samples, PFUnA concentrations ranged from 2.0 to 6.3 ng/g ww and 2.4 to 5.4 ng/g for the 3M Lab and AXYS, respectively. Average PFUnA concentrations were 3.6 ng/g and 3.9 ng/g ww for 3M and AXYS, respectively with an average fold-difference of 0.88 and a RPD of 22%. Overall, these data indicate that there was good agreement between the laboratories with and overall average fold-difference for all PFCS of 0.90 with an average RPD of 16%.

8.2.2 Surface Water

For surface water concentrations, an interlaboratory comparison of PFPeA, PFNA, PFDA, PFUnA and PFDoA was not conducted due to the great frequency of non-detects that resulted in no matched samples with measurable concentration (Table 8-3). For PFHxA only 1 matched sample had a measurable concentrations with the 3M Lab reporting a value of 16 ng/L and AYXS reporting a value of 6.9 ng/L. This resulted in a percent difference of 230% with a RPD of 79%. Likewise, only 2 matched samples had measurable PFHpA water concentrations with an average fold-difference of 0.42 and an average RPD of 89%. For PFBA, 12 matched samples had measurable concentrations that ranged from 11 to 74 ng/L and 9.1 to 92 ng/L for 3M and AXYS, respectively. Average PFBA concentrations were 21 and 22 ng/l for 3M and AXYS, respectively with an average fold-difference of 1.1 and a RPD of 12%. For PFOA, 3M reported concentrations for 10 samples while AXYS reported concentrations for 22 samples for a total of 10 matched samples. PFOA water concentrations ranged from 1.3 to 77 ng/L and 2.5 to 137 ng/L for 3M and AXYS respectively. The average interlaboratory fold-difference between measured PFBA concentrations was 0.66 with an average RPD of 39%. Overall, there was good agreement between the target analyte concentrations reported by both laboratories. Percent differences for target analytes detected in surface waters by both laboratories ranged from 20% to 140% with an overall average of 80%. Relative percent differences ranged from 1.6% to 135% with an overall average of 33%. The greatest divergence in reported PFCA concentrations was observed for one sample where the concentration of PFHpA reported by 3M was approximately five-fold greater than that reported by AXYS. Without this sample, the average fold difference between the two laboratories was approximately 1.0.

8.3 Study Fish Tissue Samples

Of the 9 perfluorocarboxylates that were analyzed in fish, the concentrations reported for PFBA, PFPeA, PFHxA, PFHpA and PFOA were dominated by values less than the LOQ (Table 8-4, 8-6, 8-8. 8-10, and 8-12). PFBA was detected in 37 of 396 fish samples with species-specific detection rate that was less than or equal to 16% (Table 8-4). PFBA was detected in 9 bluegill, 16 freshwater drum, 4 smallmouth bass and 8 white bass with concentrations that ranged from 0.05 to 5.59 ng g ww. The grand arithmetic mean (95% confidence limit) and median for all fish analyzed in this study were 0.28 (0.24-0.32) ng/g ww and 0.13 ng/g ww, respectively (Table 8-5). Of the 37 samples with detected values, only 12 samples had PFBA concentrations greater than 1 ng/g ww and none were greater than 5 ng/g ww.

PFPeA was detected in 38 of 396 fish samples with species-specific detection rate that was less than or equal to 12% (Table 8-6). PFPeA was detected in 7 bluegill, 6 freshwater drum, 22 smallmouth

bass, and 9 white bass with concentrations that ranged from 0.03 to 1.37 ng/g ww. The grand arithmetic mean and median for all fish were 0.18 (0.16-0.19) ng/g ww and 0.13 ng/g ww, respectively (Table 8-7). Of the 38 samples with detected PFPeA concentrations, only 1 sample was greater than 1 ng/g ww.

PFHxA was detected in 46 of 396 fish samples with species-specific detection rate that was less than or equal to 15% (Table 8-8). PFHxA was detected in 12 bluegill, 15 freshwater drum, 10 smallmouth bass, and 9 white bass with concentrations ranging from 0.03 to 1.19 ng/g ww. The grand arithmetic mean (95% confidence limit) and median for all fish analyzed in this study were 0.20 (0.18-0.22) ng/g ww and 0.13 ng/g ww, respectively (Table 8-9). Of the 46 samples with detected concentrations, none had concentrations greater than 5 ng/g ww and only 2 had concentrations greater than 1 ng/g ww.

PFHpA was detected in 33 of 396 fish samples with species-specific detection rate that was less than or equal to 14% (Table 8-10). PFHxA was detected in 10 bluegill, 14 freshwater drum, 3 smallmouth bass, and 6 white bass with concentrations ranging from 0.01 to 0.15 ng/g ww. The grand arithmetic mean (95% confidence limit) and median for all fish analyzed in this study were 0.04 (0.03-0.04) ng/g ww and 0.03 ng/g ww, respectively (Table 8-11). Of the 33 samples with detected concentrations, none had concentrations greater than 1 ng/g ww.

PFOA was detected in 46 of 396 fish samples with species-specific detection rate that was less than or equal to 25% (Table 8-12). PFOA was detected in 11 bluegill, 25 freshwater drum, 1 smallmouth bass, and 9 white bass with concentrations ranging from 0.03 to 1.86 ng/g ww. The grand arithmetic mean (95% confidence limit) and median for all fish analyzed in this study were 0.09 (0.08-0.10) ng/g ww and 0.05 ng/g ww, respectively (8-13). Of the 46 samples with detected concentrations, 3 had concentrations greater than 1 ng/g ww.

While concentrations of C4 to C8 PFCAs in fish collected from Pool 2 were dominated by nondetects, longer chain PFCA were detected at a much greater frequency with 55% of the fish samples reporting detected concentrations for PFNA and 100% of the sample reporting PFDA, PFUnA and PFDoA. PFNA was detected in 41 bluegill, 86 freshwater drum, 7 smallmouth bass and 84 white bass with concentrations that ranged from 0.01 to 1.13 ng g ww (Table 8-14). The grand arithmetic mean (95% confidence limit) and median for all fish analyzed in this study were 0.23 (0.21-0.26) ng/g ww and 0.13 ng/g ww, respectively (Table 8-15). Of the 218 samples with detected values, only 3 samples had PFNA concentrations greater than 1 ng/g ww and none were greater than 2 ng/g ww. Species-specific arithmetic mean (95% confidence limits) PFNA concentrations were: bluegill 0.10 (0.08-0.12) ng/g ww, freshwater drum 0.28 (0.25-0.32) ng/g ww, smallmouth bass 0.05 (0.05-0.06) ng/g ww, and white bass 0.51 (0.46-0.56). Median PFNA concentrations were 0.08, 0.26, 0.03, and 0.51 ng/g ww for bluegill, freshwater drum, smallmouth bass, and white bass respectively. The rank order from least to greatest concentration was smallmouth bass, bluegill, freshwater drum, and white bass with an overall difference of 10-fold between the least and greatest species-specific values. However, much of this difference was derived from the large number of non-detects observed for smallmouth bass, when this species was removed, the difference was only 5.6-fold. Comparison of fish tissue PFNA concentrations over the 10 sampling reaches in Pool 2 indicated that while the greatest concentrations typically were observed in Reach 10, no gradient or trend was observed across all the reaches for any of the fish species (Table 8-15).

PFDA was detected in 100% of the fish sampled in Pool 2 with concentrations ranging from 0.32 to 10.9 ng g ww (Table 8-16). The overall arithmetic mean (95% confidence limit) and median for all

fish analyzed in this study were 2.11 (1.97-2.25) ng/g ww and 1.79 ng/g ww, respectively. Of the 396 samples with detected values, 310 samples had PFDA concentrations greater than 1 ng/g ww, 17 samples greater than 5.0 ng/g ww and 1 sample greater than 10.0 ng/g ww. Species-specific arithmetic mean (95% confidence limits) PFNA concentrations were: bluegill 1.41 (1.11-1.71) ng/g ww, freshwater drum 1.74 (1.57-1.91) ng/g ww, smallmouth bass 1.74 (1.60-1.87) ng/g ww, and white bass 3.61 (3.4-3.9) (Table 8-17). Median PFDA concentrations were 0.90, 1.52, 1.63, and 3.44 ng/g ww for bluegill, freshwater drum, smallmouth bass, and white bass respectively. The rank order from least to greatest concentration was bluegill, freshwater drum, smallmouth bass, and white bass with an overall three-fold difference between the least and greatest species-specific values. Comparison of fish PFDA concentrations across all 10 sampling reaches indicated that while the greatest concentrations typically were observed in Reach 10, a concentration gradient was not apparent for any of the 4 fish species in the rest of Pool 2 (Table 8-17).

PFUnA was detected in 100% of the fish sampled in Pool 2 with concentrations ranging from 0.19 to 6.32 ng g ww (Table 8-18). The overall arithmetic mean (95% confidence limit) and median for all fish analyzed in this study were 1.22 (1.15-1.30) ng/g ww and 1.11 ng/g ww, respectively. Of the 396 samples with detected values, 221 samples had PFUnA concentrations greater than 1 ng/g ww, 10 samples greater than 3.0 ng/g ww and 3 samples greater than 5.0 ng/g ww. Species-specific arithmetic mean (95% confidence limits) PFUnA concentrations were: bluegill 0.83 (0.66-1.01) ng/g ww, freshwater drum 1.07 (0.96-1.18) ng/g ww, smallmouth bass 1.22 (1.13-1.32) ng/g ww, and white bass 1.79 (1.65-1.93) (Table 8-19). Median PFUnA concentrations were 0.61, 0.89, 1.20, and 1.69 ng/g ww for bluegill, freshwater drum, smallmouth bass, and white bass respectively. The rank order from least to greatest concentration was bluegill, freshwater drum, smallmouth bass, and white bass with an overall 2.8-fold difference between the least and greatest species-specific values. Comparison of fish tissue PFUnA concentrations across all 10 sampling reaches indicated that while the greatest concentrations typically were observed in Reach 10, equivalent concentrations of PFUnA were observed in Reaches 5 through 7 and as a result, a concentration gradient was not apparent for any of the 4 fish species in Pool 2 (Table 8-19).

PFDoA was detected in 100% of the fish sampled in Pool 2 with concentrations ranging from 0.13 to 4.75 ng g ww (Table 8-20). The overall arithmetic mean (95% confidence limit) and median for all fish analyzed in this study were 1.08 (1.01-1.14) ng/g ww and 1.00 ng/g ww, respectively. Of the 396 samples with detected values, 199 samples had PFDoA concentrations greater than 1 ng/g ww, 36 samples greater than 2.0 ng/g ww and no samples greater than 5.0 ng/g ww. Species-specific arithmetic mean (95% confidence limits) PFDoA concentrations were: bluegill 0.59 (0.48-0.70) ng/g ww, freshwater drum 1.05 (0.92-1.18) ng/g ww, smallmouth bass 1.16 (1.07-1.25) ng/g ww, and white bass 1.51 (1.39-1.64) (Table 8-21). Median PFDoA concentrations were 0.46, 0.85, 1.16, and 1.40 ng/g ww for bluegill, freshwater drum, smallmouth bass, and white bass respectively. The rank order from least to greatest concentration was bluegill, freshwater drum, smallmouth bass, and white bass with an overall three-fold difference between the least and greatest species-specific values. Comparison of fish tissue PFDoA concentrations across all 10 sampling reaches indicated that while the greatest concentrations typically were observed in Reach 10 followed by Reach 5, a concentration gradient was not observed for any of the 4 fish species in Pool 2 (Table 8-21).

Correlation analysis of PFBA, PFPeA, PFHxA, PFHpA, and PFOA tissue concentrations with fish mass, length and age resulted in few statistically significant correlations and of those correlations that were statistically significant, the correlations accounted for only a small amount of the total variation (Table 8-22). For PFCA's with carbon chains of 8 or less, the only statistically significant correlations observed in bluegill were for PFHxA and mass (p= 0.02) and length (p= 0.034) as well

as for age and PFBA (p= 0.02) and PFHpA (p= 0.002). In freshwater drum, the only significant correlation was observed between mass and PFHpA (p=0.037) where as all correlations for smallmouth bass and white bass were not statistically significant (p< 0.05). In contrast, with exception of bluegill and age (p= 0.46), all correlations of PFDoA were statistically significant for all fish species. Furthermore, the all correlations between PFUnA and fish characteristics were statistically significant (p< 0.05) while for PFDA the only correlations that were not statistically significant were for mass and length in bluegill and mass in freshwater drum. Unlike the other long chain PFCAs, PFNA demonstrated the greatest interspecies differences in that while all correlations in freshwater drum and smallmouth bass were not statistically significant (p> 0.18), all correlations with fish characteristics for bluegill and white bass were statistically significant (p< 0.05). Overall, fish mass, length and age were poor predictors of PFCA tissue concentrations.

8.4 Study Surface Water Samples

Concentrations of PFDA, PFUnA and PFDA in surface water samples collected in Round 2 (August) were all reported as less than their LOQ (Table 8-23). Furthermore, only 1 sample had detectable concentrations of PFHpA and PFNA while PFPeA and PFHxA had detectable concentrations in 3 and 4 samples, respectively. In contrast, PFBA was measured in 16 of the 30 surface water samples while PFOA was measured in 20 of 30 samples. In all instances, the location with the greatest frequency of PFC detection, as well as measured PFC concentration, was observed in the water sample collected in Reach 10 at Station 530. The location with the second greatest number of PFC detections, as well as PFC concentrations, was in water collected from Reach 5 at Station 517. In general, the surface water samples collected throughout the entirety of Pool 2 had PFCA concentrations that were predominately non-detects with the exception of those sample collected immediately downriver of known point sources to the river. The exceptions to this general finding PFBA and PFOA that were measured in surface water samples throughout Pool 2 but that had their greatest concentrations downriver of two known point sources.

While Round 1 (June) surface water samples were collected from only 14 locations and as a result can be used to evaluate the distribution of PFCs throughout the entirety of Pool 2, the results from these samples can be used to explore temporal changes in PFC concentrations at these locations (Table 8-24). The total number of detects for PFBA, PFPeA, PFHxA, PFHpA, PFNA and PFOA in these samples were 3, 3, 2, 1, 1, and 13, respectively. In general, concentrations reported in Round 1 were less than those reported in Round 2 for the same locations. For instance, the average fold-concentration difference between Rounds 2 and 1 were 3.0, 2.3, 1.7, 1.7, 1.1, and 1.3 for PFBA, PFPeA, PFHxA, PFHpA, PFNA, and PFOA, respectively. The greatest differences observed between the two sampling Rounds were observed for samples collected at Station 517/501, downstream of the 3M facility. At this location the fold difference between Rounds 2 and 1 for PFBA, PFPeA, PFHxA, and PFOA were 7.0-, 4.7-, 2.5 and 1.6, respectively. For all other locations and analyte combinations, the fold-differences ranged from 0.7 to 2.0.

Table 8-1. Intralaboratory Blind Duplicate Comparison of Perfluorocarboxylates (ng/g, wet weight) in Fish Collected from Pool 2 and Analyzed by 3M (2011)

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PFDoA	18.5	30.5	5.	2.38	7.94	9.58	7.40	0.34	13.4	19.3	20.4	13.2	6.84	16.4	0.72	0.83	1.53	11.6	12	7.91	4.34	13.3	
PFUnA	18.7	4.6 6.	18.7	0.2	8.6	10.0	9.6	0.2	13.7	14.5	6.5	1.8	80.00	19.2	4.6	0.9	3.0	28.2	32.4	5.9 2.3	8.4	14.8	
PFDA	16.3	8.36	2.79	17.4	13.6	6.73	3.99	7,52	25.2	31.3	4.52	0.26	. O	8.37	7.42	3.92	7.01	28.5	28.9	3.8 79	8.44	20.3	
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Duplicate Lad ID	019FN1	TOSENT	012FN	073FN1	121FN1	147FN1	173FN	228FM	233FNf	265FN1	275FN1	284FN1	376FW	XI.	077FN	089FN1	139FN1	169FN1	182FM	198FN/ 225FN/	244FN1	245FN1	
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Ω Q		126FN 105FN	010FN 012FN	078FN 073FN1	137FN 121FN1	170FN 147FN1	192FN 773FN		**************************************	315FN 265FN1	323FN 275FN1	334FN 284FN1	3	XI.		102FN 089FN1	159FN 139FN1	180FN 169FN1	203FN 182FW	224FN 196FN1 246FN 225FN		291FN 245FN1	
Primary Lab ID	. 2 022FN **.	726FN	100 100 100 100 100 100 100 100 100 100					258FN		Aman			447FN 376FVI	054FN 060FN	N3260				203FN	224FN 246FN			
Qi Qi			100 100 100 100 100 100 100 100 100 100						. 269FN	Aman			376FNT	060FNI						224FN 246FN			
Primary Lab ID	. 2 022FN **.	726FN	100 100 100 100 100 100 100 100 100 100	078 078FN	137 137FN	170 170FN	192FN	258 × 258FN	269 EV 269FN	315 315FN	323 323FN	334 334FN	447 4 47FN 447FN 376FNT	** ** 054* 054FN ** 060FN	N3260 260	102 102FN	159 159FN	180 180FN	203 ** ** 203FN	224 224FN 246 246FN	280 280FN	291 291FN	
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Primary Lab ID	**** *********************************	126FN	O10 OTOFN PARTY	078FN	137FN	170FN	192FN	258 × 258FN	269 EV 269FN	315FN	323FN	334FN	447 4 47FN 447FN 376FNT	** ** 054* 054FN ** 060FN	N3260 260	102 102FN	159FN	180FN	203 ** ** 203FN	224FN 246FN	280 280FN	291 291FN	
Field ID Primary Lab ID	. 2 022FN **.	726FN	100 100 100 100 100 100 100 100 100 100	078 078FN	137 137FN	170 170FN	192FN	258FN * 258FN * 4	269 EV 269FN	315 315FN	323 323FN	334 334FN	447 4 47FN 447FN 376FNT		N3260 260	102FN	159 159FN	180 180FN	203FN	224 224FN 246 246FN	280 280FN	291 291FN	

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Perfluorocarboxylate Res

Table 8-1. Intralaboratory Blind Duplicate Comparison of Perfluorocarboxylates (ng/g, wet weight) in Fish Collected from Pool 2 and Analyzed by 3M (2011)

								Rei	Relative Percent Difference (RPD, %)	nt Differe	nce (RPD,	(%)		
Reach	ch Species		Field ID	Primary Lab ID	Duplicate Lad ID	ID PFBA	PFPeA	PFHXA	PFHpA	PFOA	PFNA	PFDA	PFUnA	PFD ₀ A
℃	Smallmouth bass Smallmouth bass		(S)	383FN	324FN1 339FN1				Fr.a			2.41 7.70	8. 1	15.6 758
	Smallmouth bass		390	390FN	347FNT	Wei.	Y'ai					15,3	5.4	2.56
4	Smallmouth bass		436	436FN	375FN1							16.0	15.9	18.3
80	White bass	0	033	033FN	042FN1							26.8	5.6	17.3
80	White bass	0	045	045FN	043FN1							21.0	8.9	17.9
2	White bass		065	065FN *								9.38	8.4	67.0
ja /~ #	White bass		£.	T13FN	090FN					* ***	2.0	6.82	8,7	8,78
် န	White bass		· · · · · · · · · · · · · · · · · · ·	149FN	122FN1				• ** **		1,4	6.91	93	122
9	White bass	2	214	214FN	184FN1						0.6	12.3	16.8	4.33
4	White bass	2	232	232FN	210FN1						8.8	7.06	3.1	7.94
(.)			346	346FN	314FN1						20.3	14.2	15.8	17.6
8	. White bass		70,	370FN	327FN1		ln ll j	e s		87 ×8	23.3	33.5	24.4	13.4
eu J	White bass	7.4.		400FN	348EN1			e F	i ip		13.1	F ₀	<u>5</u>	7.18
7	White bass	7	411	**************************************	357FM		e ga				0,2	16.5	.03	£ <u>7</u> 8.
თ	White bass	4	425	425FN	371FN1						8.0	14.6	14.3	26.9
	White bass	4	450	450FN	406FN1						18.9	3.17	4.8	7.52

All reported RPD values were for samples that had paired results greater than the LOQ

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Table 8-2. Interlaboratory Comparison of Perfluorocarboxylates (ng/g, wet weight) in Fish Collected from Pool 2 and Analyzed by 3M and AXYS (2011)
Relative Percent Difference (RPD, %)

PFDoA									13.38						
PFUnA	99						The state of the s								
PFDA										96		22.98			
PFNA				H 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1											
PFOA	20000													¥ × ×	
PFHpA										E g					
PFHxA										\$. 4.				*	
PFPeA										10 K 10 K 10 K					
PFBA										Name of the last o					
AXYS Lab ID	019FN1 105FN1 012FN1	073FN1	121FN1	147EN1 173EN1 228EN1 233EN1	265FN1	275FN1	284FN1 376FN1 060FN1 077FN1	089FN1	139FN1	169FN1 182FN1	196FNI 225FNI	244FN1	245FN1	255FN1	324FNI
										*			_		
3M Lab ID	022FN 126FN 010FN	078FN	137FN	170FN 258FN 269FN	315FN	323FN	334FN 447FN 054FN	102FN	159FN	180FN 203FN	224FN 246FN	280FN	291FN	302FN	360FN
Field ID	126	820	137	170 192 258 258	315	323	334 (447) (654) (654) (692)	102	159	180 ************************************	224	280	291	302	360
Species	10 Bluegill Bluegill 10 Freshwater drum	Freshwater drum	Freshwater drum	Freshwater drum Freshwater drum Freshwater drum Freshwater drum	Freshwater drum	Freshwater drum	Freshwater drum Freshwater drum Smallmouth bass Smallmouth bass	Smallmouth bass	Smallmouth bass	Smallmouth bass	Smallmouth bass Smallmouth bass	Smallmouth bass	Smallmouth bass	Smallmouth bass	Smallmouth bass
Reach		-	တ	0	80	9		-	10	**************************************	48	2	7	7	m m

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Table 8-2. Interlaboratory Comparison of Perfluorocarboxylates (ng/g, wet weight) in Fish Collected from Pool 2 and Analyzed by 3M and AXYS (2011)

					,		ě	Relative Percent Difference (RPD, %)	ent Differe	ence (RPD,			<u>-</u>
Reach	Species	Field ID	3M Lab ID	AXYS Lab ID	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnA	PFDoA
œ	Smallmouth bass	383	383FN	339FN1	of 98			5	¢	866	16 16 18	20	3
	1				40		A	1 29 E 2	2016 2016 2017				ESE IN
ວາ ု	Smallmouth bass	2300	390FN	347FN1	, 78 , 300	15				k n	4		r r P
4	Smallmouth bass	436	436FN	375FN1					150	560	- C		E .
80	White bass	033	033FN	042FN1							<u> </u>		
∞	White bass	045	045FN	043FN1							;		
2	flite bas	990	065FN	. 068FN1	. 4	66 9	10		### #**				3 3 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
	White bas	1/3	113FN	PNF090	ily S (M)				. Hi	<i>5</i>			
#	White bas	149	149FN	122FM		Park And				Ma Ma Maria	Σ	ke eg Kurus	
	White bass	214	214FN	184FN1	3H 863 3	#! #***	#' #	,	p p	H		*	
4	White bass	232	232FN	210FN1							5 63	0.77	
В	White bass	346	346FN	314FN1							200		
7 7 7	White bass	370	370FN	327FN1		i i	2007 1	S.		4		i i	
. n)	White bass	400	400FN	348FM	1				1 1	# #	t E	Tp.	
7	white bass	ä	#Jg	357FN1							3 8	1	/ (/ ()
6	White bass	425	425FN	371FN1		ir i		*** ** _*	e e e e e e e e e e e e e e e e e e e	, ar	74.3	lic _i	
1	White bass	450	450FN	406FN1							16.99	34.3	5.73
All representations IIA													5

All reported RPD values were for samples that had paired results greater than the LOQ

Table 8-3. Interlaboratory Comparison of Perfluorocarboxylates (ng/L) in Surface Water Collected from Pool 2 During Rounds 1 and 2 and Analyzed by 3M and AXYS (2011) Relative Percent Difference (RPD, %)

	PFDoA									M. Fr. St. St. St. St. St. St. St. St. St. St		75 on margin 55 of 200877 com on 75						E						
	PFUnA			* »			K.			iig.				## ## ## ## ## ##				10 No.						
	PFDA	* * * * * * * * * * * * * * * * * * *										ş	80° 110° 110° 110° 110° 110° 110° 110° 1	* * * * * * * * * * * * * * * * * * *	40 A			1	# 38 ⁸					
יפ (ארט, יי	PFNA			# #			6		2 9F			!		e e				¥	· 如 · · · · · · · · · · · · · · · · · ·					
т ыпегепс	PFOA	· · · · · · · · · · · · · · · · · · ·		E S			100 LL 200			H H			24.58	* .		37.69		10 0000000	32.87			;	69.42	66.32
Keiative Percent Difference (NPD, 70)	PFHpA			E E E E E E E E E E E E E E E E E E E			2000 - 4-00000 - 000			AND THE PERSONAL PRINCIPAL			E X		10 X			18 mm 7 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0						
	PFHxA		4 ° 9 × 7 × 7	* * *			***************************************						24.57					!						
	PFPeA	%; 		8 H 5 H 5 K																				
	PFBA			**************************************						25.	2		77.52			3.51	6.57		6,94				32.98	
	AXYS Lab ID	512SF2	513SF2	514SF2	509SF2	510SF2	511SF2	506SF2	507SF2	508SF2 533SF2	534SF2	535SF2	530SF2	531SF2	532SF2	527SF2	528SF2	529SF2	524SF2	525SF2 F26SF2		503SF2	504SF2	505SF2
	3M Lab ID A	512SF1	513SF1	514SF.	509SF1	510SF1	511SF1	506SF1	* * * * * * * * * * * * * * * * * * *	= 508SF1 == = = = = = = = = = = = = = = = = =	534SF1	535SF1	530SF1	531SF1 **	532SF1	527SF1	528SF1	529SF1	524SF1	525SF1	3	503SF1	504SF1	505SF1
	Field ID	542	213	514	509	510	511	909	le Heta		534 534	535	2.089		ini og	_{**}	528	529	1729	525	27	503	504	505
	Reach	3	4 × × × × × × × × × × × × × × × × × × ×	# # # # # # # # # # # # # # # # # # #	2	2	2	S.	į.	4 18	4 4	4		. in	i io	· · · ·	9	9	# # # # # # # # # # # # # # # # # # #			∞	∞	∞

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Table 8-3. Interlaboratory Comparison of Perfluorocarboxylates (ng/L) in Surface Water Collected from Pool 2 During Rounds 1 and 2 and Analyzed by 3M and AXYS (2011)

(RPD, %)	PENA PEDA PEDOA			
Relative Percent Difference (RPD, %)	PFOA	06 00 12 08 00 12	09.00	42.62
Relative Perce	PFHpA	67.73	20.70	
	PFHxA	2003	00.7	
	PFPeA	To the distribution of the	00.50	
	PFBA	2.76 5.41 5.92	33.81	1.60
	AXYS Lab ID	518SF2 519SF2 520SF2 501SF2	502SF2	515SF2
	3M Lab ID	518SF1 519SF1 520SF1 501SF1	502SF1	515SF1
	Field ID	Far.	502	515
	Reach	9 520 10 501	: 6	10

All reported RPD values were for samples that had paired results greater than the LOQ

Table 8-4. Descriptive Statistics for PFBA (ng/g, wet weight) in Fish Collected From Pool 2 and Analyzed by 3M (2011)

ALL SAMPLES			Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
Arithmetic Mean [PFBA] Number of Defects	9	0.38		0.26
Number of Non-detects Number of Samples Not Reported	90 -	887	2 00 00 00 00 00 00 00 00 00 00 00 00 00	88
Maximum [PFBA]	3.12	4.59	0.54	2.41
Minimum [PFBA]	0.05	0.05	0.05	0.05
Median [PFBA] Geometric Mean [PFBA]	0.13	0.18	0.18	
Standard Deviation	0.42		0,15	0.32
1/0 Discontinuity of the property of the contract of the contract of the property of the contract of the contr				

Table 8-5. Mean and 95% Confidence Intervals for PFBA Concentration (ng/g, ww) in Fish Collected in Pool 2 by Reach (2011)

							Keach	cu			
Species	Statistic	-	2	က	4	2	9	7	∞	1	9
	Wean	0.2	0.38	0.35	0.11²	0.43	0,222	0.12	442	Z0.0,	0.33
Bluegill	and a			Par Va			J.	10.08,0.16	** 6,	**************************************	i i
	Mean	0.231	o	0.29^{1}	0.31^{2}	0.13^{1}	0.56 ²	0.57²	8	0.15	0.93
Freshwater drum		ı		ı	1	1	,		1	[0.09, 0.22]	34, 1.5
Smallmouth bass	Mean			16 0.24 0.2	4	0.131	0.22²		0.25	0.17	0.292
# # # # # # # # # # # # # # # # # # #	il ^e	* "		La	* 2	7 7		1 70 1 7		0.001	0.35
2004 04:4/1/	Mean	-60.0	0.51	0.36	0.20	0.15	0.74	0.10	0.30	6.00	3.5
VVIIICE DASS	95% CI		1	•	•	•		•	ı		•

¹ All samples < LOQ; only mean DL reported

Table 8-6. Descriptive Statistics for PFPeA (ng/g, wet weight) in Fish Collected From Pool 2 and Analyzed by 3M (2011)

ALL SAMPLES			openes	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
Arithmetic Mean [PFPeA]		2	0.22 and a second secon	
Number of Samples Not Reported		**************************************		
Maximum [PFPeA]	0.50	0.50	1.37	0.50
Minimum [PFPeA]	0.01	0.01	0.03	0.01
Median [PFPeA] Geometric Mean [PFPeA] Standard Deviation	0.17 0.17 0.17	0.13 0.12 0.16	0.15	0.13 0.16
		on de de la company de la comp		

^{1/2} RL was used as a proxy value for all non-detects

² Sample size ≤ 2; only mean reported

Table 8-7. Mean and 95% Confidence Intervals for PFPeA Concentration (ng/g, ww) in Fish Collected in Pool 2 by Reach (2011)

							Reach				
Species	Statistic	-	7	က	4	5	9	7	∞	6	9
JIDO	Mean 95% Cl	1919	is .	0.351	0.09	0.122	0.07	0.132	32 0.127	25010	.0.261
reshwater drum	Mean	0.192	0.141	O.	0.111	0.121	0.082	0.08	in.	0.04	i
	95% CI		•	1	,	1	•	,	,	[0.02 0.06]	•
- 2	Mean Mean 95% CI	24.2	ġ.,i	4 0.22	0.78	181°0	0.18' 0.162 0.172	27.0	0.32	710 01	' 3 '
White bac	Mean	0.05	0.222	0.201	0,082	0.071	0.111	0.112	0.34	0.041	0.21
VVIIITE DASS	95% CI	ı		,	ı	•	•	•		ı	•

¹ All samples < LOQ; only mean DL reported

² Sample size ≤ 2; only mean reported

Table 8-8. Descriptive Statistics for PFHxA (ng/g, wet weight) in Fish Collected From Pool 2 and Analyzed by 3M (2011)

ALL SAMPLES			Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
Arithmetic Mean IPFHXAI Number of Defects Number of Non-defects	0.19	0.24	0.16	
Number of Samples Not Reported	-	0	0	0
Maximum [PFHxA]	1.07	0.79	0.50	1.19
Minimum [PFHxA]	0.03	0.03	0.03	0.03
Median [PFHxA]. Geometric Mean [PFHxA] Standard Deviation	0.13 0.13	0.178 0.178 0.178	0.12	0.15

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Table 8-9. Mean and 95% Confidence Intervals for PFHxA Concentration (ng/g, wet weight) in Fish Collected in Pool 2 by Reach (2011)

							Reach				
Species	Statistic	-	2	60	4	ıc	9	7	&	6	10
III)SenIII	Mean 95% CI	0,241	0.38	0.332	0,15	7 .	2.00 Mag. 11	000	0.152	777	0.281
ř	Mean	0.222	0.171	342	0.222	0.131	0.10	0.141	0.472	0.37	0.251
Freshwater drum	95% CI	,	1		,		[0.05, 0.15]		ı	[0.18, 0.56]	
	Wean	150 150 150 150 150 150 150 150 150 150	Ē	0.18	2713		2	0.092	0.092	017	0.58
75 Table 1	Mean	0.131	0.241	0.23	0.132	0.15	0.141	0.122	0.332	0.17	0.37
White bass	95% CI	•	•	1	1	•	ı	1	•	[0.09, 0.24]	[0.15, 0.59]

¹ All samples < LOQ; only mean DL reported

² Sample size ≤ 2; only mean reported

Table 8-10. Descriptive Statistics for PFHpA (ng/g, wet weight) in Fish Collected From Pool 2 and Analyzed by 3M (2011)

ALL SAMPLES			Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
Arithmetic Mean [PFHpA] Number of Detects Number of Non-detects	10.04 10 90	\$ 8.5.5 \$ 5.00 \$ 5.0	2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2	0003
Number of Samples Not Reported	0	0	0	0
Maximum [PFHpA]	0.13	0.15	0.13	0.13
Minimum [PFHpA]	0.01	0.01	0.01	0.01
Median [PFHpA] Geometric Mean [PFHpA] Standard Deviation	800 800 800 800	0.03	0.00	0.03

Table 8-11. Mean and 95% Confidence Intervals for PFHpA Concentration (ng/g, wet weight) in Fish Collected in Pool 2 by Reach (2011)

	·					Reach					
Species	Statistic	-	7	က	4	5	9	7	8	6	10
	Mean	0.04	0.04	032	33	0,042	190'0	16000	1860 L	2010	0,021
	≥ 10 %36	, =	.03, 0.05					z z s			
Freshwater drum	Mean	0.05	0.042	0.04	0.041	0.031	0	0.021	0.021	0.0	0.032
	95% CI	[0.02, 0.09]		[0.02, 0.06]	•	1	•	,	1	i	ı
	Mean	0,022	.051	0.031	0.051	No. of Street, or	0.11	0,081	0.03	0.032	0.072
	95% CI		l'air		1		. J.		T _{St}		
White base	Mean	0.032	0.041	0.031	0.031	0.031	0.082	0.041		0.02	0.012
2000	95% CI	•	1	,	,	1	ı	•	•	1	1

¹ All samples < LOQ; only mean DL reported

² Sample size \leq 2; only mean reported

Table 8-12. Descriptive Statistics for PFOA (ng/g, wet weight) in Fish Collected From Pool 2 and Analyzed by 3M (2011)

ALL SAMPLES			Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
Arithmetic Mean [PFOA]	000	N. 0.12.	800	80:0
Number of Non-defects	88	75		
Number of Samples Not Reported	0	0	0	
Maximum [PFOA]	1.10	1.86	0.18	0.40
Minimum [PFOA]	0.03	0.03	0.03	0.03
Median [PFOA] Geometric Mean [PFOA]	90.0	9000	0.05	2000
Standard Deviation		0.24	0.04	20.02

Table 8-13. Mean and 95% Confidence Intervals for PFOA Concentrations (ng/g, wet weight) in Fish Collected in Pool 2 by Reach (2011)

Mississippi River Pool 2 PFC Assessment – Fish Tissues and Water – Summer 2011

						NEGCII					
Species	Statistic	-	2	က	4	2	9	7	8	6	10
	Mean	0,062	0,071	0.192		88	. 0,042	0.11	0.04	0,101	
Bluegill	%36	4				3804 ₁₈				i	[0.05, 0.19]
	Mean	0.091	0.112	0.09	0.05	0.13	90:0	0.092	0.072	0.071	0.45
Freshwater drum	95% CI	1	•	[0.07, 0.12]	[0.03, 0.08]		[0.02, 0.09]		1	i	[-0.03, 0.93]
	Wean	0.06	0.13	0.061	0.04	0.062	0.051	0.11	0,081	£	000
%	S 95% CI	8	a a a								
	Mean	0.072	0.09	0.0	0.042	0.092	0.102	0.101	0.082	0.071	0.082
White bass	95% CI	1	•		r	•	1				

1 All samples < LOQ; only mean DL reported

² Sample size ≤ 2; only mean reported

Table 8-14. Descriptive Statistics for PFNA (ng/g, wet weight) in Fish Collected from Pool 2 and Analyzed by 3M (2011)

ALL SAMPLES			Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
Arithmetic Mean [PFNA]	0.10	0,28	900	** F20° **
Number of Detects		98		
Number of Non-detects	65		66 ×	A A A A A A A A A A A A A A A A A A A
Number of Samples Not Reported	0	0	0	0
Maximum [PFNA]	0.56	0.95	0.13	1.13
Minimum [PFNA]	0.03	0.03	0.01	0.05
Wedian IPFNAI		0.26	000	. 0.50
Geometric Mean [PFNA]	80.0	0.24	0.04	0.42
. Standard Deviation	80'0	7.0	700	97.0
A 10 To Total Commence of the Latest Authority	oto C	AND THE PROPERTY OF THE PROPER		

Table 8-15. Mean and 95% Confidence Intervals for PFNA Concentrations (ng/g, wet weight) in Fish Collected from Pool 2 by Reach (2011)

						Ke	Reach				
Species	Statistic	-	2	3	4	22	9	7	8	6	9
Beng	Mean	0.162	27. 0	0.092	80.0	0.08	200	1900	90'0	0.12	0.16
Frechuster drum	Mean	0.27	0.37	.33	0.04 0.111 II0 0.25	(0.03, 0.13) 0.30	[1] [0.03, 0.13] [0.04, 0.09] [1.0.04, 0.09] [1.0.04, 0.09] [1.0.04, 0.09] [1.0.04, 0.09]	0.30	[0.03, 0.08] 0.21	[0.03, 0.08] [0.08, 0.17] [0.05, 0.28] 0.21 0.29 0.26	[0.05, 0.28] 0.26
riesilwatei diulii	95% CI	[0,14	[0.20, 0.55]	[0.21, 0.46]	[0.17, 0.32]	[0.22, 0.39]	[0.15, 0.36]	[0.19, 0.41]	[0.11, 0.31	[0.15, 0.43]	0.55] [0.21, 0.46] [0.17, 0.32] [0.22, 0.39] [0.15, 0.36] [0.19, 0.41] [0.11, 0.31 [0.15, 0.43] [0.09, 0.44]
<u> </u>	Mean	# 18 18	5 . 1 1	0.052	0.032	0.03	JE0:0	0.08	0.041	LZ000	0,081
	15 %CS		4			[0.02, 0.04]					
White bass	Mean	0.47	0.63	0.50	0.68	0.45	0.71	0.44	0.42	0.47	0.33
	95% CI	95% CI [0.21, 0.73] [0.39,	[0.39, 0.87]	[0.32, 0.69]	0.87] [0.32, 0.69] [0.56, 0.79]		[0.37, 0.52] [0.53, 0.89]	[0.32, 0.55]	[0.20, 0.64]	[0.26, 0.68]	<u>o</u>
¹ All samples < LOQ; only mean DL reported	; only mean DL	L reported									

² Sample size ≤ 2; only mean reported

Table 8-16. Descriptive Statistics for PFDA (ng/g, wet weight) in Fish Collected From Pool 2 and Analyzed by 3M (2011)

ALL SAMPLES			Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
Arithmetic Mean [PFDA] Number of Detects Number of Non-detects	0	1.74	1,74	3.00
Number of Samples Not Reported	0	0	0	0
Maximum [PFDA]	10.92	4.78	3.84	7.47
Minimum [PFDA]	0.32	0.47	0.53	0.92
Median [PFDA] Geometric Mean [PFDA] Standard Deviation	0.90	1.54	69.0	344.
1/0 D	A Company of the Comp		(4) (1) (1) (1) (1) (1) (1) (1) (1) (1) (1	

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Table 8-17. Mean and 95% Confidence Intervals for PFDA Concentrations (ng/g, wet weight) in Fish Collected from Pool 2 by Reach (2011)

Species Statistic 1 2 3 4 5 Bluegill Mean 1.51 1.81 1.96 0.99 1.17 Freshwater drum 95% CI [0.66, 2.35] [0.57, 3.05] [1.31, 2.61] [0.71, 1.27] [0.78, 1.56] Freshwater drum 95% CI [0.87, 2.28] [0.76, 2.39] [0.97, 2.04] [0.80, 1.48] [1.69, 2.90] Smallmouth bass 95% CI [0.97, 1.98] [1.51, 2.89] [1.34, 2.28] [1.74, 2.51] [1.43, 2.06] White bass 95% CI [1.94, 5.37] [3.31, 4.92] [2.24, 4.24] [2.73, 3.96] [2.80, 4.57]	0.99 1.14 [0.80, 1.48] 2.13 [1.74,2.51] 3.35 [2.73, 3.96]	5 1,17 10.78, 1.56] 2.30 [1.69, 2.90] 1,75 [1143, 2.06] 3.68 [2.80, 4.57]	六 	6 7 0.86 0.51 1.34 2.13 [0.88, 1.79] [1.56, 2.69] 1.30, 2.16] [1.35, 2.13] 3.91 3.57 [3.24, 4.59] [2.48, 4.66]	8 0.78 1.66 1.66 1.22, 2.11] [1 39] [1.22, 2.11] [1 39] [0.95, 2.00] [0 3.11 36] [2.70, 3.53] [3	9 1.46 82, 2.10] 2.06 5.4, 2.58] 1.20 88, 1.52] 3.89 .15, 4.64]	10 3.04 [0.39, 5.70] 2.13 [1.37, 2.89] [1.30, 2.40] 3.60 [2.48, 4.72]
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¹ All samples < LOQ; only mean DL reported

Table 8-18. Descriptive Statistics for PFUnA (ng/g, wet weight) in Fish Collected From Pool 2 and Analyzed by 3M (2011)

ALL SAMPLES			Species	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
Arithmetic Mean [PFUnA] Number of Detects Number of Non-detects	100	100	1.22	
Number of Samples Not Reported	0	0	0	0
Maximum [PFUnA]	6.32	2.65	3.87	5.46
Minimum [PFUnA]	0.19	0.27	0.27	0.58
Median [PFUnA] Geometric:Mean [PFUnA] Standard Deviation	0.65	0.80	1.20 1.15 0.48	1.69

^{1/2} RL was used as a proxy value for all non-detects

² Sample size ≤ 2; only mean reported

1

Table 8-19. Mean and 95% Confidence Intervals for PFUnA Concentrations (ng/g, wet weight) in Fish Collected from Pool 2 by Reach (2011)

						Re	Reach				
Species	Statistic	1	2	က	4	5	9	7	∞	6	10
iii)	Mean 95% CI	0.65	0.99	1077, 1.50	0.59 [0.48, 0.69]	0.59	0.68 0.36	0.36	0.57	0.89	1.94
water	Mean	0.95	1.01	0.76	0.76	1.44	0.92	1.50	0.81	1.21	1.32
	95% CI	[0.60, 1.29]	0.5	[0.60, 0.92]	[0.55, 0.97]	[1.06, 1.83	[0.46, 1.38]	[1.14, 1.85]	[1.14, 1.85] [0.59, 1.03] [0.90, 1.52]	[0.90, 1.52]	10.87. 1.761
	Mean	108	1.27	Ξ	99')	129	1.29	80.		60	
	95% CI	[0.76, 1.40]	[1.00, 1.54]	0, 1.54] [0.92, 1.30] [r	[1.05, 2.08]	17,716, 1,42]	[1.05, 2.08] [1.16, 1.42] [1.06, 1.52] [[[0.84, 1.32]	0.30, 1.2	2] [0.75, 1.19]	0.95, 2.19
White has	Mean	2.01	1.94	1.51	1.65	1.81	2.01	1.87	1.60	1.85	
Willie Dass	95% CI	[0.94, 3.07]	[1.55, 2	.34] [1.14, 1.88]	[1.36, 1.94]	[1.31, 2.30]	[1.31, 2.30] [1.63, 2.39]		[0.95, 2.80] [1.39, 1.81] [1.39, 2.32] [1.42, 2.07]	[1.39, 2.32]	[1.42, 2.07]
1 All samples < LOO: only mean DI reported	Oulv mean D	reported									

All samples < LOQ; only mean UL reported

Table 8-20. Descriptive Statistics for PFDoA (ng/g, wet weight) in Fish Collected From Pool 2 and Analyzed by 3M (2011) ALL SAMPLES

			checke	
Statistic	Bluegill	Freshwater drum	Smallmouth bass	White bass
Arithmetic Mean [PFDoA] Number of Detects Number of Non-detects	0000	1.05 100-	000	C = 00 = 00
Number of Samples Not Reported	0	0	0	0
Maximum [PFDoA]	3.91	3.13	3.36	4.75
Minimum [PFDoA]	0.13	0.25	0.24	0.29
Median [PFDoA] Geometric Mean [PFDoA] Standard Deviation	0.46 0.47 0.56	0.85	920	000
1/0 DI man line and antique constant and book and the Color	11.11.11.11.11.11.11.11.11.11.11.11.11.			

^{1/2} RL was used as a proxy value for all non-detects

² Sample size ≤ 2; only mean reported

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Table 8-21. Mean and 95% Confidence Intervals for PFDoA Concentrations (ng/g, wet weight) in Fish Collected from Pool 2 by Reach (2011)

						Reach	ç			3.5	
Species	Statistic	-	2	3	4	5	9	7	∞	6	10
	Mean	10.35	* D.Q. *	0.82	0.53	<u>6.047</u> 0.32 0.48 0.52 0.48 0.32 0.48 0.32 0.48 0.32 0.48 0.32 0.48 0.32 0.48 0.32 0.48 0.32 0.48 0.33 0.48 0.33 0.48 0.33 0.48 0.33 0.48 0.33 0.48 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.3	0.52	6.32	0,48	79'0	8
Bluegill	95% CI	0.25, 0.46	[0.26, 0.68]	[0.51, 1.14]	[0.36, 0.69]	[0,24, 0,65]	[69'0 '98'0]	[0.24, 0.39]	[0,36, 0,60]	[0.33, 0.91]	[0.43, 2.34]
	Mean	0.82	0.95	0.74	0.89	1.57	0.98	1.59	0.62	1.07	1.29
Freshwater drum	95% CI	[0.43, 1.21]	[0.29, 1.62]	95% CI [0.43, 1.21] [0.29, 1.62] [0.44, 1.04]	[0.57, 1.21]	[0.95, 2.18]	[0.57, 1.39]	[1.13, 2.06]	[0.46, 0.79]	[0.77, 1.38]	[0.89, 1.70]
8 ***		80)		100	1.26	132		16'0	807	160	Ę
Smallmouth bass	95% CI	95% CI [0.80, 1.36]	. Oj.	[0.78, 1.23]	[1.03, 1.50]	2, 1143] [0.78, 1123] [1.03, 1.50] [1.08, 1.55] [0.93, 1.29] [0.74, 1.19] [0.65, 1.51] [0.69, 1.12] [1.15, 2.27]	[0.93, 1.29]	[0.74, 1.19]	0.65, 7.51	[0.69, 1.12]	Pl.15, 2.27]
State of the state	Mean	2.01	•	1.28	1.46	1.34	1.84	1.38	1.51	1.51	1.39
White bass	95% CI	95% CI [0.44, 3.59] [1.29,	[1.29, 1.94]	[0.92, 1.64]	[1.10, 1.81]	1.94] [0.92, 1.64] [1.10, 1.81] [0.95, 1.74] [1.48, 2.20] [0.97, 1.80] [1.22, 1.80] [1.22, 1.80] [1.10, 1.68]	[1.48, 2.20]	[0.97, 1.80]	[1.22, 1.80]	[1.22, 1.80]	[1.10, 1.68]

¹ All samples < LOQ; only mean DL reported

² Sample size ≤ 2; only mean reported

Table 8-22 Correlations of Perfluorocarboxylates Fillet Concentrations with Species Specific Fish Characteristics (ND=0)

	_	*						Tilga Rygge	·	* */
	PFDoA	0.3368	0.0006	100	0.2923	0.0032	100	-0.0750	0.4604	66
	PFUnA	2745	0057	100		0.0015	100	2396	2169	66
	ā	Ö	6		o.	Ö	•	Ö		
	PFDA	0.0728	0,4716	9	0.1253	0.2142	100	0.2260	0.0245	96
	PFNA	-0.2001	0.0460	\$	-0.2135	0.0329	100	-0.3409	900000	66
=										
Bluegi	PFOA	0.1137		100	0.0637	0.5290	100	7060'0-	0,3749	66
	PFHpA	2980'0	0.3908	100	-0.1382	0.1703	100),3642	3,0002	66
	_		7		'			4		
	PFHxA	-0.2342	0,0196	66	-0.2129	0.0344	66	-0.1122	0.2713	88
	eΑ	38	69		03	31			· · ·	4
	PFPeA	E	0.18	8	0.1603	0.1131	66	0.0	0.39	86
	FBA	.0167	8701		.0614	2460	66	23T	6μ0	86
	٦	9	Ö		P	0.5		19. .		31 14
	Statistic	Spearman r	p-value	u	Spearman r	p-value		Spearman	p-value_	i i
			o l			<u> </u>			di	
	Correlation		Ws [P]			Length vs [PFC]	9		Age vs [PFC	
		ď,	•	#		ت		i L	Æ	Fe/1

Freshwater drum	PFHXA PFHDA PFOA PFNA PFDA PFUNA PFDOA	0.0017 -0.2085 0.0228 -0.1141 0.1678 0.4559 0.5744	0.9866 0.0374 0.8219 0.2584 0.0952 < 0.0001 < 0.0001 100 100 100 100	-0.178	0.9028 0.2120 0.0326 < 0.0001	100 100 100 100 100 100	-0.1413 -0.1185 -0.1308 -0.1331 0.4338 0.3999 0.3284 0.1609 0.2404 0.1947 0.1868 < 0.0001 0.0009	ANN ANN
	PFPeA P	0,0023	3 =	0.0348	0.7309 0	100	0.3740	
	PFBA	0.00144	0.9107 100		0.5142	100	0.2303	
	Statistic	Spearman	p-value n	Spearman r	p-value		Spearman i p-value	¢
	Correlation		Mass vs [PFC]		Length vs [PFC]	1000000	Age vs [PFC]	

	PFDoA	0.03191	0.2752	0.0056	100	0.2718 0.0062				PFDoA	0.3935	0.3960	< 0.0001	96	.3345	60000	96
	F			0.	•					Ŗ.		³ O) >			2. 2 Marken 25.	* # #
	PFUnA	0.0006	0.2791	0.0049	100	0.2428	100			PFUnA	0.4266 <0.0001	0.4065	< 0.0001	96	0.3901	× 0.000	8
	4		Σ.	22		0.8				A	all miles		001		. 28	, 100	
	PFDA	0.3422	0.2721	0.0062	10	0,2470	100			PFDA	0,4764 < 0.0001	0.4828	< 0.0001	96	0,4426	<0.000	8
	PFNA	0.0384	0.0054	0.9578	100	0.0385	.			PFNA	0,5422 <0.0001	0.4937	< 0.0001	96	0,3125	0.0019	
bass									SS						k s Pa		
Smallmouth bass	PFOA	0.0348 0.7309 100	0.0174	0.8634	100		400		White bass	PFOA	0.3389		0.4516	96	-0.0714	0,4897	96
Sm	PFHpA	0,1949	0.2054	0.0404	100	0.2151 nmats	8			PFHpA	0.4124	-0.0892	0.3876	96	0.1247	0,226f	96
	품		. 0	0.0	`	u.				ä		, O	0.		(e) (e)		
	PFHxA	0.797	0.1093	0.2791	100	0,1081 0.2845	100			PFHxA	-0,1705	.0.1800	0.0793	96	-0.1546	0.1327	96
	PFPeA	0.4530	-0.0897	0.3747	100	-0.0898 0.374E	100			PFPeA	0.0295	35 0.0461	0.6559	96	0.0175	1,8655	# 96 # 96
	F	0.0	 9	0.3	-	34 Q	ne H			Ŗ.	0.7769		0.0		Ģ	76	
	PFBA	0.0821	0.0764	0.4500	100	0 0	100			PFBA	0.1147	95 0 1034	0.3163	96	(5)	0.3789	96
	<u>.2</u>		an r	. 0						Ęį	# 8 #	* 5			anr	p-value	
	Statistic	Spearman r p-value	Spearman r	p-value		Spearman r	eniev-d	re ND		Statistic	Spearman r p-value	Spearman r	p-value		Spearman r	p-val	* F
	<u>io</u>			[PFC]	•	E 8.		mples we		tion	- E	ar i	IPFC		14 14 14 14		
	Correlation	Mass vs [PFC]	E.	Length vs [PFC]	,		Age vs [PTC]	1 99% of samples were ND		Correlation	Mass vs	ere Co	Length vs [PFC])	And the second	Age vs [PFC]	
			S) di			k, sta	ħ.e €	٦				TWO			\$ 2°	h a	¥ _t .E S

Table 8-23. 3M Analysis of Round 2 Water Samples for Perfluorocarboxylates (ND=RL)

PFDoA	<2.0	- 230 - 230	< 2.0	< 2.0	< 2.0	< 2.0	× 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 20	< 2.0	< 2.0	< 2.0	< 2.0	× 20 × 20 × 20
PFUnA	< 2.0	2.0	< 2.0	< 2.0	< 2.0	× 2.0 %	×20 ×20	< 2.0	< 2.0	< 2.0	< 2.0	< 20=	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	<2.0	< 2.0	< 2.0	< 2.0	< 2.0	<20 <20
PFDA	<2.0	3 S	< 2.0	< 2.0	< 2.0	8 5	22	< 2.0	< 2.0	< 2.0	~25°	<20	<20	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0 < 2.0
PFNA	\$ 2.0	202	< 2.0	< 2.0	< 2.0	< 2.0	2 0 2 2 7 2 4	< 2.0	< 2.0	< 2.0	< 2.0	<2.0	< 2.0	< 2.0	< 2.0	< 2.0	ZZ 200	<2.0	< 2.0	< 2.0	< 2.0	< 2.0	<2.0
PFOA	6.12	279	3.59	2.52	3.55	3.46	\$ 20	4.57	2.75	< 2.0	4.73	2.26	< 2.0	23.3	2.97	< 2.0	< 2.0	2.32	2.51	< 2.0	< 2.0	2.77	3.16 2.20
PFHpA	<2.0 <2.0	7 6	< 2.0	< 2.0	< 2.0	< 2.0 **	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	<20	< 2.0	< 2.0	< 2.0	< 2.0	<20	×20	< 2.0	< 2.0	< 2.0	< 2.0	\$ 20 \$ 20
PFHxA	2.96	31.7	< 2.0	< 2.0	< 2.0	<220 245	200	< 2.0	< 2.0	< 2.0	< 2.0	<20	< 2.0	3.29	< 2.0	< 2.0	<20	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	× 20 × 20
PFPeA	6.05	74.6	< 5.0	< 5.0	< 5.0	6.02	× 200 × 200	< 5.0	< 5.0	< 5.0	< £.0	SS V.	<5.0	< 5.0	< 5.0	< 5.0	×5.0	< 5.0	< 2.0	< 5.0	< 5.0	< 5.0	0.50 5.00 5.00
PFBA	78.6 79.5	888	14.7	11.4	16.4	7.2	0.07	16.7	< 10.0	< 10.0	16.8	, S	× 10.0	39.1	< 10.0	< 10.0	ā	0:0.	< 10.0	< 10.0	< 10.0	12.8	× 100 100 100 100 100 100 100 100 100 100
Reach	2 4	2	တ	თ	တ	· σ - α	2	7	7	7	9	9	9	2	2	2	4		¥ * * * * * * * * * * * * * * * * * * *	က	လ	က	N N
Lab ID	515SF1 516SF1	517SF1	518SF1	519SF1	520SF1	521SF1 529SE1	523SF1	524SF1	525SF1	526SF1	-527SF1	528SF1	529SF	530SF1	531SF1	532SF1	533SF1	534SF1	535SF1	536SF1	537SF1	538SF1	539SF1 540SF1
Tissue ID	515SF 516SF	517SF	518SF	519SF	520SF	521SF 527SF	523SF	524SF	525SF	526SF	527SF		529SF	530SF	531SF	532SF	533SF	534SF	535SF	536SF	537SF	538SF	539SF 540SF
Field ID	515	517 517SF	518	519	520	521	523 523F	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	mail self-self-self-self-self-self-self-self-

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<u>Z</u> .	1SF1		< 5.0	\$20 **	\$ 2.0	2.34	<20	93 S	<2.0	, V.2.0
542SF1	Ξ		< 10.0	< 5.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	0.2.>	0.2 >
543SF1	5	_	11	< 5.0	< 2.0	< 2.0	2.53	< 2.0	< 2.0	< 2.0	< 2.0
544SF1	_	_	12.2	< 5.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Bold, italicized text = Detects

November 2012

Table 8-24. 3M Analysis of Round 1 (June) Water Samples for Perfluorocarboxylates (ND=RL)

PFDoA	4 40 4 0	<4.0	< 4.0	< 4.0	< 4.0	< 4.0	0; V	^ 0.4.0	< 4.0	< 4.0	< 4.0	< 4.0	4
PFUnA	< 4.0 < < 4.0	0.7>	< 4.0	< 4.0	< 4.0	4 0	<4.0	<40	< 4.0	< 4.0	< 4.0	< 4.0	× 20.
PFDA	<2.5 <2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	<2.5	< 2.5	< 2.5	< 2.5	<2.5	× 2.5
PFNA	< 2.0 < 2.0	< 2.0	< 2.0	< 2.0	< 2.0	<2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	<.20
PFOA	737	< 2.0	4.56	2.53	2.81	2.25	2.24	2.06	2.15	< 2.0	< 2.0	< 2.0	2.23
PFHpA	07.7 V	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
PFHxA	728	<2.5	< 2.5	< 2.0	< 2.5	< 2.5	<2.5	< 2.5	< 2.5	< 2.5	< 2.5	<25	< 2.5
PFPeA	. 16 . 4.83	<4.0	< 4.0	< 4.0	< 4.0	<4.0	4.0	< 4.0	< 4.0	< 4.0	5.15	×4.0	<4.0
PFBA	92.4	,	9.14	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	<5.0	< 5.0
Reach	0,	æ	∞	∞	က	m)	_ m	2	7	2	-		
Lab ID	501SF1 502SF1	503SF1	504SF1	505SF1	506SF1	507SF1	508SF1	509SF1	510SF1	511SF1	512SF1	513SFI	514SF1
Tissue ID	501SF 502SF	503SF	504SF	505SF	506SF	507SF	508SF	509SF	510SF	511SF	512SF	513SF	514SF
Field ID	504 502	503	504	505	206	205	508	209	510	511	512	513	54

Chapter 9

Conclusions

The analysis of all fish and water samples for perfluorinated compounds was conducted by the ISO17025 Accredited 3M Environmental Laboratory. For quality assurance, 30 water samples representing all 3 sampling locations within each reach and 41 fish representing 10% of the total number of fish analyzed by the 3M Laboratory were also analyzed by ISO17025 Accredited AXYS Analytical Ltd.

With one exception, the data agreement for fish tissue samples was good between the laboratories with the average relative percent differences (RPD) for PFAS and PFCAs generally being 25% or less. PFBS was the exception with an average RPD of approximately 90%; however, the significance of this difference is difficult to evaluate given that it was based on only 2 samples. A comparison of the PFOS analytical results for fish indicated a very good match (RPD range 1.3-54%, mean of 17%) between the two laboratories. The interlaboratory comparison based on water PFC concentrations was limited due to the large number of non-detects reported by both laboratories. Using data from matched samples with measured concentration in both laboratories, the RPD ranged from 1.6 to 135% with an overall arithmetic average and median of 36% and 33%, respectively. For PFOS, the RPD ranged from 17 to 56% with an average of 35%.

PFOS water concentrations were detected only in Reaches 5, 6, 7, 8, 9, and 10 with all other samples having concentrations less than the LOQ. The greatest concentration was measured in Reach 10 at Station 517 with the second greatest concentration being measured in Reach 5 at Station 530. PFOS concentrations decreased with distance downriver from these two locations indicating the potential presence of point sources of PFOS to the river. With the exception of Stations 517 and 530, all water concentrations were less than the site-specific water quality value of 7.0 ng PFOS/L established by the MPCA. With the exception of PFBA and PFOA, the other PFAS and PFCA compounds were detected in patterns similar to that observed for PFOS with concentrations being greatest near Reaches 5 and 10. Measurable surface water PFBA and PFOA concentration showed a more ubiquitous distribution in that, while concentrations were greatest in Reach 10, they were also measured throughout the entirety of Pool 2 indicating that additional sources of these compounds to the river may exist.

Detectable concentrations of PFOS were measured in all fish collected from Pool 2. PFOS concentrations in all fish samples from Pool ranged from 3.17 to 757 ng/g ww. Arithmetic mean, geometric mean, and median fish PFOS concentrations were 46.3, 31.1 and 34.1 ng/g ww, respectively. The arithmetic means for bluegill, freshwater drum, smallmouth bass and white bass were 36, 46, 39, and 64 ng/g ww, respectively. While some statistically significant correlations were observed between PFOS concentrations and fish length, weight and age, for the targeted species, the correlations were weak and typically accounted for less than 20% of the variation for any specific correlation. Based on arithmetic average, the greatest concentrations were observed in white bass followed in decreasing order by freshwater drum, smallmouth bass, and bluegill. Concentrations of PFBS, PFHS, PFOSA as well as that of the other nine PFCAs were measured in all fish species but the species-specific average concentrations were less than 5 ng/g ww on a pool wide basis. Overall, the most dominant PFC measured in fish collected from Pool 2 of the Upper Mississippi River was PFOS.

Chapter 10

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Appendix A

Fish Sample Collection Tables & Figures

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November 2012

Fish Sample Collection

A.1 Tables

Table A-1. 3M Analysis of Fish Tissue Samples for PFCs (ND = RL)

Taxa abbreviations: Freshwater drum = F drum; Smallmouth bass = Sm bass; White bass = W bass; Green sunfish = G sunfish

A ₀ Q ₃ q	7 8	2.01	2.05	1.11	F 9. 1) 8	0.30		2 73	3 1	2.28	3.18	1.30	92.0
AnU39	183	2,19	1.86	1.31	2 2 3	0/3	77	;), 2 7	213	2.56	5.28	1.57	200
₽₽₽¥	2,00	2.45	1.91	2.70	8 8 3	89 ,	1,06	3	1 5	3.05	7.47	7.96	2.10	22'0
PFNA	0.12 82.8	0.95	0.23	0.34	6 G	9.0	0.26	<0 ×	0.50	3 8	0.84	< 0.25	< 0.25	<0.25
₽ 044	1.36	0.20 1.57	0.22	0.22	200 to 100 to 10	\$0.1	< 0.1	<0.1) 10 ×	a e	0.13	<0.1	0.36	0.12
AqH79	<0.025	<0.025 <0.025	< 0.025	< 0.025	\$2002 \$0.025 \$4	< 0.025	<0.025	0.03	<0.025	<0.025	< 0.025	< 0.025	< 0.025	×0.025
AxH7q	<0.5	< 0.5 < 0.5	< 0.5	¢();2	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	< 0.5	< 0.5	< 0.5	<0.5	40.5 410	1.19	× 1.0	< 1.0	· 0'.'>
₽₽₽₽₽	\$40.5 \$40.5	<0.5 <0.5	5.0 >	¢.0.>	e 0.00 8 8 8	<0.5	< 0.5	< 0.5	<0.5	60 V	< 1.0	< 1.0	< 1.0	<1.0
₽FBA	67.9	< 0.5 0.86	< 0.5	cn:o	20.5 20.5 288	0.94	0.51	<0.5	979	8 P	<1.0	< 1.0	<10	×1.0
A≳O74	8 8	2.56	1.19	26.7	0.45 0.52 0.27	0.17	0.20	1.00	3.67	6 82 8 82	10.40	0.16	0.19	0.78
PFOS	83.5	607.0	23.2	STATE OF THE PARTY	77.7	29.1	21.5	40.5	121	1 3	394.0	214.0	52.0	29.5
SH±d	\$ 7 7 1 1 4 6 7 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	0.11	< 0.05		<0.05 <0.05 <0.05	<0.05	< 0.05	< 0.05	0.05	0.13 0.12	1.33	< 0.05	< 0.05	< 0.05
583d	60.25 60.25	<0.25	< 0.25		-0.25 -0.25 -0.25	< 0.25	< 0.25	< 0.25	\$2.0 >	<0.25 <0.1	<0.1	< 0.1	< 0.1	.0×
End Westing	W92° 53.313 W92° 53.313		W92° 53.313' W92° 53.313'		W92* 62.52.1* W92* 52.52.1* W92* 62.52.1*	W92° 52.521'	W92° 52.521'	W92° 52.521'	W92° 52.52†	W92° 52.521° W92° 52.521°	W92" 52.521'	W92° 52.521'	W92° 52 521'	W92*52.521
gnitesW hale	W92" 55.010 W92" 55.010 W92" 55.010	W92° 55.010'	W92° 55.010' W92° 55.010'		W92° 54.778 W92° 54.778	W92° 54.778'	W92° 54.778'	W92° 54 778'	W92" 54 778"	W92° 54.778'	W92° 54 778'	W92° 54.778'	W92° 54.778	W92°54.778
End Northing	N44" 46 926 N44" 46 926 N44" 46 926	N44° 46.926	N44" 46.926' N44" 46.926'		N44° 45.382 N44° 45.382	N44° 45.382'	N44° 45.382'	N44° 45.382'	N44° 45.382	N44" 45.382 N44" 45.382	N44° 45.382'	N44° 45.382'	N44° 45.382'	N44° 45.382
gnidhoM Frat2	N44° 47.108 N44° 47.108	N44° 47.108′	N44° 47.508' N44° 47.108'	,	N44* 46.426 N44* 46.426 N42* 46.428	N44° 46.426'	N44° 46.426'	N44° 46.426'	N44° 45.428°	N44° 46.428' N44° 46.428'	N44° 46.426'	N44° 46.426'	N44° 46.426°	N44° 46.426
uny	-1	-			n a a	2	5	2	2	4 4	2	2	7	2
Кеасh	2 2 2 12.00	10	5 b		10 10	5	5	9	۹.	2	0	5	۷ .	e .
(w) agA	2/1/3/18	ક	3 10		2 2 v	S,	œ	2	7	and the second s	2	7	9	CZ .
Sample length (whole body, cm)	2 A %	32	39.5		9 5 8	90	34	27	8	24.5	98	16	17.5	18.5
Sample mass (whole body, g)	548.54 85.173 788.88	376.48	798.32	20,71,01	825.54 825.54 376.48	326.59	326.59	235.87	249.48	20865 175.90	226.80	99.79	38	3 7 3 7
(nommos) sxsT	F drum F drum F drum	F drum	F drum W bass	11.00	F G T T T T T T T T T T T T T T T T T T	F drum	F drum	W bass	W bass	W bass	W bass	Bluegill	Bluegill	Blue
Ol døJ	ODFNI OOZFNI OOSFNI	004FN1	005FN1 006FN1	DOZENA	008FN1	010FN1	011EN1	013FN1	014FN1	O16FN1	017FN1	018FN1		02/FN1
Ol sussiT	001FN 002FN 003FN	004FN	005FN 006FN	OO7FN	Magna Mark	010FN	011FN	013FN	014FN		017FN	018FN		WZIFN
Eield ID	10 70 E		900	200				013 0	7				1	

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Table A-1. 3M Analysis of Fish Tissue Samples for PFCs (ND = RL)

1	A ₀ G ∃ q	15. 17.	1.36	1.34	0.85		0.78	1.09	0.28	新安	1.59	1.32	0.45	* * * * * * * * * * * * * * * * * * *	1.16	0.91	1.86	
	AnU79	6.32 1.67	1.20	1.40	0.89	0.53	0.95	1.23	0.72	18 178 128	1.43	1.72	0.67	9 8 9 2 5 2	1.15	1.16	2.14	
	AG34	10.92	1.55	1.83	1.44	88 17 88 158 88 1	1.93	1.29	1.57	3.68 2.69	3.12	3.01	1.25	Z Z Z	2.16	2.07	4.63	8 8 5
	ЬЕИ∀	0.56	< 0.25	< 0.25	< 0.25	0.25 0.25 0.25	< 0.25	< 0.25	< 0.25	0.28 0.25	0.24	0.31	0.18	F 75	0.20	< 0.1	0.39	3 5 5
	بغد			< 0.1 <	<01 <	15 8 8	< 0.1	< 0.1	<0.1		<0.1	< 0.1	< 0.1	5 5 5	<0.1	<0.1	< 0.1	2000
	₩		5 <0.1															
ا	AqH4q	<0.025	< 0.025	< 0.025	< 0.025		< 0.025	< 0.025	< 0.025	2000 2000 2000 2000 2000 2000		< 0.05	< 0.05	A DESCRIPTION OF THE PROPERTY	> 0.05	> 0.05	0.05	
sunfish	AxH4q	× 1.0	< 1.0	< 1.0	< 1.0	S P S	< 1.0	< 0.1	1.07	C Prince Company	<10	× 1.0	<10	\$ \$ \$	< 1.0	<1.0	< 1.0	
= G	₽FP∉A	, , , , , , , , , , , , , , , , , , ,	<10	< 1.0	< 1.0		<1.0	0.1.0	× 1.0	<1.0<1.0<1.0<1.0	< 1.0	< 1.0	< 1.0	0 0 0 0 V	<10	< 1.0	<10	
Green sunfish	A8∃9	1.00 × 1.00	<10	< 1.0	< 1.0	2 2 5	< 1.0	< 1.0	<10		< 1.0	< 1.0	< 1.0	0 0 0	<1.0	<1.0	<10	
reen s	₽FO3 A	99 G	0.72	1.10	0.91	9.00 0.00 0.63 0.63	0.22	0.49	60'0	86.0 88.0	96'0	1.19	0.12	\$ \$ 3	0.15	3.90	173	7 9 C
	PF0S	305.0	44.4	41.7	35.0	2 2 E	34.9	16.0	9.7	2 8 X	53,5	50.1	33.5	8 4 4	33.9	59,5	799	98 E
= W bass;	PFHS	0.26 < 0.05	< 0.05	< 0.05	< 0.05	0.13	< 0.05	< 0.05	91.0	<0.05 0.08 <0.05	0.14	× 0.1	c 0.1	5 5 5	< 0.1	0.17	< 0.1	<0.1 <0.0 0.03
Sm bass; White bass	bŁB2	5 5	<0.1	< 0.1	< 0.1	20 00 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 2	< 0.1	< 0.1	< 0.1	, 10 PO	< 0.25	< 0.25	< 0.25	-023 -025	< 0.25	< 0.25	< 0.25	-0.25 -0.05
; Whit					_			_		5 8 5	ii i				, 366,	,666.0	1933	06.085 06.085
n bass	End Westing	W92° 52.52	W92° 52.521	W92° 52.521	W92° 52.521	W93* 01.521'	W93" 01.521	W93* 01.521	W93° 01 521	W93° 01.521 W93° 01.521 W93° 01.521	W93° 01 118'	W93° 01 118'	W93* 00.999	.696.00 .E6M	W93° 00.999'	W93* 00.999'	W93° 00.933'	West Kalbe
- 11	BuitsəW hal2	W92" 54.778" W92" 54.778	W92° 54.778'	W92° 54.778'	W92° 54.778'	W93* 01.399* W93* 01.399* W93* 01.399*	W93° 01.399'	W93° 01.399'	W93° 01.399'	W93* 01.399 W93* 01.399	W93° 01.340'	W93° 01,340'	W93° 01.438'	W93* 01.438 W93* 01.438	W93° 01.438'	W93° 01.438'	W93° 00.454'	W93* 06.777 W93* 06.777
mallmouth bass		N44° 45.382°	N44° 45.382′	N44° 45.382'	N44° 45.382'	N44° 47.471° N44° 47.471° N44° 47.471°	N44° 47 471'	N44° 47.471'	N44° 47.471	N44* 47.477 N44* 47.471 N44* 47.471	N44° 47 086°	N44° 47.086°	N44° 46.447'	N44" 46.447. N44" 46.447. N44" 46.447	N44° 46.447'	N44° 46.447'	N44° 48.290°	NAT' SOUR
(ND - NL) = F drum; Smallr	gnidhoM hst2	N44* 46.428: N44* 46.426	N44° 46.426'	N44° 46.426°	N44° 46.426'	NA4* 47.743* NA4* 47.743* NA4* 47.743	N44° 47 743'	N44° 47.743'	N44° 47.743°	N44° 47.743° N44° 47.743° N44° 47.743	N44* 47.649'	N44° 47.649'	N44° 47.171'	N44" 47,171" N44" 47,471" N44" 47,171	N44° 47 171'	N44° 47 171'	NA4° 40.258	N44 55 509
drum = F.	uny	, w			8		-	-	-		48. N	7	60		8	e 8	7 4	
s tor r	Кеасћ	0 0	10	9	5	& & &	80	80	∞		8	80						
Fresh	(yr)	101	. n	က	2	a 1 2 a	1	2	4		1	7	60		13	5	CNI	W. C. C.
sene c	Sample length (whole body, cm)	4		27.5	89	8 6 8	32.5	27	41	28.5 Z7 27.5			88	* 38 %	32	, 25.5	8.	
ISN III Orevial	Sample mass (whole body, g)	108.86 27.770	 	285.76	789.25	666.78 667.74 349.27	399.16	249,48	36.29	Z76.80 Z78.80 Z49.43	199.58	235.87	498,95	308.4	439.98	185.97	97078	368.44 368.44 368.44
able A-1. 3M Analysis of Fish 11ssue Samples for Fr Cs Taxa abbreviations: Freshwater drum	Taxa (common) sxsT	Bluegli	Smbass	Sm bass	Sm bass	Form Participation of the part	F drum	Sm bass	Bluedill		. 1	W bass	F drum	Farm Farm	F drum	W bass	*	F dum
M Ana	Gi da⊿	DZZFNI	024FN1	025FN1	026FN1	027FN1 028FN1 029FN1	030FN1	031FN1	032FN1	033FNT 034FNT	036FN1	037FN1	038FN1	CAGENT CAGENT	044FN1	045FN1	# L	048FN1 048FN1
	Ol eussi∏	022FN	COZEN	025FN	026FN	N-7750 N-7850 N-7850	030FN	031FN	032FN	033FN 034FN 035FN	036FN	037FN	O38FN	OMOFIN CATEN	044FN	045FN	₹19 8 0	OdB-N
l able	Field ID	00.2	024 024	025	026	028	030	031	032	034	038	037	038	98	044	045	*	048 048

Taxa abbreviations: Freshwater drum = F drum; Smallmouth bass = Sm bass; White bass = W bass; Green sunfish = G sunfish Table A-1. 3M Analysis of Fish Tissue Samples for PFCs (ND = RL)

	Aoaqq	0.70	0.45	0.80	5 2 5	1.32	0.83	0.91	8 5 4	1.05	1.31	1.10	8 8 8	0.36	0.40	0.24	3 3 5	0.25	1.31
	Anuaq	1.07	0.84	1.12	8 2 2	1,64	1.33	1.35	7.7 7.7	0.72	1.72	1.10	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.82	1.02	0.74	2.18	97.0	1.07
	AG49	2.59	2.72	2.46	282 42	3.28	2.16	1.91	2.03	1.15	3.85	2.09		1,47	2.02	171	6 5 E	1.33	1.28
	bEN¥	0.38	< 0.25	< 0.25	0.02 0.02 0.02 0.03	< 0.25	< 0.25	< 0.25	*0.28 *0.28 *0.28	< 0.25	< 0.25	< 0.25	100 100 100 100 100 100 100 100 100 100	< 0.25	0.25	< 0.25	3 3 8	< 0.25	< 0.25
	AO∓q	< 0.25	< 0.25	< 0.25	\$2.025 \$2.025 \$2.025	< 0.25	< 0.25	< 0.25		< 0.25	< 0.25	< 0.1	<025 <025 <01	< 0.1	< 0.1	< 0.1	\$ \$ \$	< 0.1	< 0.1
	AqHaq	0.09	90'0	< 0.05	< 0.05 < 0.05 < 0.05 < 0.05	9.05	< 0.05	< 0.05	× 0.05 × 0.05	< 0.05	< 0.05	< 0.05	<0.05 <0.05 0.05	90.0	90.0	< 0.05	\$0.05 9.06 0.13	0.10	90'0
	Ахнтч	< 1.0	< 1.0	<10	×10 ×10 ×10	<1.0	< 1.0	<1.0	y y y	<10	<10	<10	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0	<10	< 1.0	< 1.0	\$10 \$10 \$10	< 1.0	< 1.0
200	A∍q∃q	< 1.0	< 1.0	< 1.0	0.00	< 1.0	< 1.0	<10	0 0 0	<1.0	× 1.0	<10	0 0 v	< 1.0	< 1.0	<10		< 1.0	×10
	A839	<1.0	<10	<1.0	8 9 8 5 5 8	× 1.0	<1.0	<10	Ç 0, 0	< 1.0	× 1.0	< 1.0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	< 1.0	< 1.0	< 1.0	e e e	<1.0	<1.0
200	ASO79	0.14	0.18	1.17	3 8 F	0.15	0.10	0.12	0.20	0.22	2.10	1.48	9000	20.0	0.10	90.04	900 1700	0.12	0.33
Dass,	PFOS	43.7	37.1	29.1	30.0 71.3	29.2	17.2	26.6	28.7	34.1	2.99	34.9	76.8	11.0	9.5	0.7	274	35.2	16.9
2	PFHS	0.03	90.0	0.05	<0.025 <0.025 22.48	0.85	0.18	0.16	<0.0025 2.0025 <0.025	0.35	< 0.025	9.05	0.028	0.21	0.12	90.0	<0.025 203 0.38	0.05	< 0.025
ווני ממי	bEB\$	< 0.05	< 0.05	< 0.05	90°00	< 0.05	< 0.05	< 0.05	\$0.05 \$0.00 \$0.00	0.40	< 0.05	< 0.05	<0.08<0.05<0.05	< 0.05	< 0.05	< 0.05	4.005 4.005 4.005	< 0.05	< 0.05
Da33, 11	End Wesding	W93° 06.085	W93° 06.085'	W93" 06.085'	W93* 05.240 W93* 05.240	W93" 05.240"	W93° 05.240'	W93° 05.240'	W83*05.240 W93*06.663 W93*06.683	W93° 09.231°	W93" 09.064"	W93° 09.064'	W33" 09.064" W93" 09.064"	W93" 09.064"	W93° 09.064'	W93" 09.064"	W93* 07.907* W93* 07.907* W93* 11.459	W93" 11.459"	W93* 11.459
D 2000	Start Westing	W93° 06.777'	W93° 06.777	W93° 06.777'	W93* 06.019 W93* 06.019	W93* 06.019'	W93° 06.019'	W93" 06.019"	W93" 05.683 W93" 05.683	W93° 09.916'	W93° 09.874'	W93° 09.874"	W93* 09.874 W93* 09.874	W93° 09.874'	W93° 09.874'	W93° 09.874°	W93" 08.945' W93" 12.049	W93° 12.049'	W93° 12.049'
Ollianious	End Northing	N44° 56.048'	N44° 56.048'	N44° 56.048'	N44" 56.048 N44" 56.589 N44" 56.589	N44° 56.589'	N44° 56.589°	N44° 56.589'	N44" 55.588" N44" 55.511" N44" 55.611"	N44° 53.823'	N44° 53.865'	N44° 53.865'	N44" 53865 N44" 53865 N44" 53865	N44° 53.865'	N44° 53.865'	N44° 53.865'	N44" 54.639 N44" 54.639 N44" 54.149	N44° 54.149°	N44° 54.149
1	gnirthoN Just	N44° 55.509'	N44° 55.509°	N44° 55.509'	N44" 55.509 N44" 56.139 N44" 56.139	N44° 56.139°	N44° 56.139'	N44° 56.139°	N44" 56.139 N44" 56.528 N44" 58.528	N44° 53.659°	N44° 53.664'	N44° 53.664°	N44" 53.664" N44" 53.664"	N44° 53.664'	N44° 53.664'	N44° 53.664°	N44° 53.871 N44° 53.871 N44° 54.511	N44° 54.611′	N44° 54.611'
	Вил	-	-	-	- " "	2	7	7	N 6 6	+	7	2	2 2 2	2	2	7	B	-	-
מנכו	Кеасћ	8	ო	ю		m	ю	က		2	2	7	a a a	7	2	7		-	~
10011	(ту) өрА	8	16	7	\$ Q 7	o	4	S	4 4 C	4	S	2		ю	2	9	2 2 1 10	80	7
eviations.	Sample length (whole body, cm)	59	જ્ઞ	35.5	40 27	15	4	15.5	30 15	16	35	26.5	13.5	13	13	12.5	2. S. S.	98	44.5
	Sample mass (whole body, g)	226.80	426.38	526.17	739.36 249.48 68.04	86.18	77 11	77 11	86.88 93.79 86.741	86.18	467.20	217 72	8 9 S	49.90	36.29	36.29	839.15 376.48 517.10	716.68	1165.73
ו מעמ מאטו	(nommos) sxsT	F drum	F drum	W bass	W bass Sm bass Bluegill	Bluegill	Bluegill	Bluegill	Bluegili Smedili Smbass	Sunfish	W bass	W bass	III III III III III III III III III II	Bluegill	Bluegill	Bluegill	W basss F drum F drum	F drum	Sm bass
	Ci de l'O	050FN1	051FN1	052FN1	OSSENI OSSENI OSSENI	056FN1	057FN1	058FN1	OSSENT VALUE OSSENT	063FN1	064FN1	065FN1	1066PM 1066PM 1066PM	070FN1	071FN1	072FN1	075EN1	078FN1	079FN1
	(Il sussiT	050FN	051FN	052FN	Z Z X	056FN	057FN	058FN	Search Search Search	063FN	064FN	065FN	NH N	070FN	071FN	072FN	OZEN OZEN OZEN	078FN	079FN
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Table A-1. 3M Analysis of Fish Tissue Samples for PFCs (ND = RL)

	A oū∃4	0.88	2	8 8	0.73	0.24	0.53	eg v	0.29	1.04	0.39	0.79	, and	6 A	0.20	0.52	0.18	123	178	262	0.77	1.03	<i>E7</i>	
	Anuaq	1.08	, 15	980	0.80	0.40	0.95	27.0	82.00	0.75	0.51	0.89		0.82	0.34	1.37	0.41	1,46	. 188 0.53	370	0.91	1.30	131	
	A079	1.83	9.70	1	0.97	0.65	2.12	48.6	3 2 2	0.91	1.26	1.53		\$ \$ 5	0.77	4.45	0.68	787	ž ŭ.	4.43	1.87	2.34	274	
	Ь⊧и∀	< 0.25	20 0 1	\$0.00 \$0.00 \$0.00	< 0.25	< 0.25	< 0.25	70.0	× 0.28	< 0.25	< 0.25	0.56		S 50 00 S 80 M	< 0.25	0.31	< 0.25	8	0.25 0.25	8.0	< 0.25	< 0.25	0.37	Ē.
	₽FOA	<0.1		3 6 5	<0.1	< 0.1	< 0.1		ê 2 8	< 0.1	<01	< 0.1		\$0.1 \$0.1	< 0.1	< 0.1	< 0.1	< 0.1	10, 10	40.1	< 0.1	< 0.1	Ţ	
	AqHaq	< 0.05		edits code	< 0.05	< 0.05	< 0.05		0005 0003 00025	< 0.025	0.03	0.12		960 day	90.0	0.04	< 0.025	50.03	\$2005 \$0025	€889	< 0.025	< 0.025	×0.005	A Vice
lsh	Ахняч	<1.0			< 1.0	. 01.	× 1.0		0.025 0.025	< 0.25	< 0.25	< 0.25		029 <025 <025	< 0.25	< 0.25	< 0.25	<0.25	\$20 \$20 \$40 \$40 \$40 \$40 \$40 \$40 \$40 \$40 \$40 \$4	€ 0.35	< 0.25	< 0.25	1006	3.
G sunfish		410		9 9 8	<1.0	. 0.1.0	< 1.0		0,10	< 0.1	<0.1	40		10° 60° 10° 10° 10° 10° 10° 10° 10° 10° 10° 1	< 0.1	< 0.1	< 0.1	292		<0.1	< 0.1	< 0.1		T
п	A∍q4q									< 0.25	< 0.25 <	300		-0.25 -0.25 -0.23	< 0.25	< 0.25	< 0.25	6.25	50.25 82.02 82.02 82.02 82.02 83.02 83.03 83 83.03 83.03 83 83 83 83 83 83 83 83 83 83 83 83 83	2	< 0.25	< 0.25		× 0.25
n sunfish	Agad	< 1.0		8 8 8 *********************************	1 <10	r <1:0	\$ <10						20 miles							15	0.61	> 88.0		4.05
bass; Green	PFOSA	79.0	35		0.28	0.04	0.05		0.03 0.03 0.03	0.30	90.0	6	1	0.00	0.05	0.08	7 0.04	-						70.4
bass;	\$04d	27.3			3	بن بن	6.4	All Care	3 2 3 1	13.5	25.8	Š	30.0		4.7	11.0	5.7	111		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	25 29.0	32.7		1
SS = W	PFHS	< 0.025		<0.025 <0.025 <0.025	< 0.025	0.10	0.03	0 - Carrier 1997	500 S	< 0,025	0.03	;	83.0	400 CO	0.11	0.22	0.05	700	e e	5000	< 0.025	< 0.025	Ĭ.	900
White bass	PFBS	< 0.05		2008 2008 2008	<0.05	< 0.05	<0.05	Contraction of the last of the	< 0.05< 0.05	< 0.05	< 0.05		c 0.0 >	0.05 < 0.05 < 0.05	< 0.05	< 0.05	< 0.05	CORS	\$0.05 \$0.05	8	< 0.05	200	8	×0.0×
bass; Wh	Eud Westing	W93* 11.459	OF.11	M93* 11.459 W93* 11.459 W93* 11.459	MIO3* 44 A50'	W93° 11.459′	M93° 11 459'	201	. 11,459 11,459	W93" 11.443"	W93* 11.443	!	W93° 11.443'	W93" 11.443" W93" 11.443" WS3" 11.443	W93" 11.443"	W93° 11.443'	W93" 11.443'	W02* 48 574	W93* 10.274	27.11.723	W93" 00.580'	,002 00 E00	000,000	W83* 00.580*
Sm ba		.K93°	2						Wes.	7							-	T.			_		50 50 60 60 60 60 60 60 60 60 60 60 60 60 60	
- 11	Start Westing	M93° 12 049'	93 12.043	W93* 12.049* W93* 12.049 W93* 12.049		240.21 CSN	010001000000000000000000000000000000000	183 12.043	W93* 12.049 W93* 12.049 W93* 12.049	W93* 12.036	M93° 12 036		W93° 12.036	M93* 12.036 W93* 12.036 W93* 12.036	W93° 12.036	W93° 12.036′	W93° 12.036°	T T SCALE	W83 11 441	2000	M03° 00 813'		W93" 00.813	W93" 00.813"
mouth bass						24.740 24.140		54.148	54.149				54.001	4* \$4,001 4* \$4,001 4* \$4,001	54 001'	54.001	54.001		808 808 808		0000	2	49.790	44*49.790
Smallm	End Northing	NA4* EA 140'	N44 94	N44*54.149 N44*54.149	SIII:8 4	8 4 8	۰	N44' 24	7 4 8 8 N 8 N 8 N 8 N 8 N 8 N 8 N 8 N 8 N	N44° 54	NA4°EA	5	N44° 54	NA NA SA	N44° 54	<u>,</u>	N44°5					1	N44° 2	 ₩
drum; S	gridhoV hate	1	N44° 54.611	N44° 54.811 N44° 54.811		N44" 54.611	- FD:	N44° 54.611'	N44° 54.611° N44° 54.811° N44° 54.611°	N44° 54.606'	900	N44 - 54.500	N44° 54.606'	N44° 54.606° N44° 52.606° N44° 54.606°	NAA" 54 606'	N44° 54.606′	N44° 54.606'		N44° 63972 N44° 53972	20200	2000	N44 50.200	N44° 50.286'	N44° 50.286°
<u> </u>		Ì		<u> </u>		A40	*		3 3 3	2 M4		2 2	2 N4	2 Z Z	· ·		Ž		F 7		-		2 N	2 N
	Кеасh Кеасh		-			-	-	-				-	-					-	-		-	1	7	
hwatel	Age (yr)		2			e .	ထ	9	Ф 4 и			c o	9	6 6 9	i i	ם ער	, u		w/ /	7	4 0	ო	4	2
Fresh	(whole body, cm)		42.5	9 8 :	6	3 8	र्	16	3 2 3	2	8	*	35	g 12 2		5. 5 5. 5		?	8 8	*	6	8	88	8
ations	(whole body, 9)	1				_				y La	18,700	349.27	467,20	417.30 86.18	2	86.18 80.18		=	347 54 288.95	208.65	86 15	675.85	648.64	186.97
hhrevi	Sample mass		1188.41				77.11	77 11		i,														
able A-1. 3M Analysis of Fish Hissure Samples for 1 55 Taxa abbreviations: Freshwater drum	(nommon) sxsT		Sm bass	Sm bass Sm bass	Sm bass	Sm bass	Bluegill	Binegill	Bicania .		Smbass	F drum	F drum	Edrum Bluedii	Renic	Bluegill	iii ii	III.Benia	W bass	Smbless	T Dass	Sm bass	Sm bass	Wbass
ı Anaı) T	al deJ		080FN1	081EN/1 082FN1	083FN1	084FN1	085FN1	086FN1	088FN1	E I	092FN1	093FN1	094FN1	098FM1	TALL IGA	098FN1	21.880	100FN1	10'FNT 102FN	103FN1	N. I	106FN1	107FN1	108FN1
۱-۱. ک <u>اچ</u>	Ol suzziT		080FN (083FN	084FN	085FN	086FN			092FN	093FN	094FN	095FM 096FM	N. L.	098FN	N-680	100FN	101FN 102FN	103FN	N TEST	106FN	107FN	108FN
l able /	Eleiq ID		080		083	084 06	082	0 980	74.	146"	092	093	194		į Š			100	101 29	103	Ħ	106	107	108

Table A-1. 3M Analysis of Fish Tissue Samples for PFCs (ND = RL)

Taxa abbreviations: Freshwater drum = F drum; Smallmouth bass = Sm bass; White bass = W bass; Green sunfish = G sunfish

Aodaq	928	2.82	1.43	66.0	77. 70. 00.	0.45	0.75	1.95	172 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.	0.31	1.21	1.29	7	1.50	1.00	1.38	97.
A nU⊣¶	0.45	5.46	1.77	1.33	72.77	0.70	98.0	2.19	8 2 5	09.0	1.34	1.63	0.88	1.53	96.0	1.82	2 5 4 T
₽EDA	2,58	7.46	3,59	3.19	30 20 1,22	1.52	1.89	4.67	3.45	1.12	2.89	2.12	70 1 128 1.28	2.89	1.31	4.53	202 202 200 214
bEN₩	<0.25	0.65	< 0.25	0.35	3.60	0:30	< 0.25	0.27	0.75	< 0.25	0.44	< 0.25	<0.25 0.265 <0.26	< 0.25	< 0.25	< 0.25	\$50.0 \$20.0 \$40.00 \$40.00
AOaq	<0.1	< 0.25	< 0.25	< 0.25	<0.26<0.25<0.25	< 0.25	< 0.25	< 0.25	<0.25 <0.25 <0.25	< 0.25	< 0.25	< 0.25	<0.25 <0.1	< 0.1	< 0.1	< 0.1	5 5 5
AqH¬q	<0.025 <0.025	< 0.025	< 0.025	< 0.025	<0.025 <0.025 <0.025	< 0.025	< 0.025	< 0.025	0.004 < 0.0025 < 0.0025	< 0.025	< 0.025	< 0.025	<0.025 <0.025 <0.025	< 0.025	< 0.025	< 0.025	<0.025 <0.025 <0.025
АхНЭЧ	<0.25	<0.1	< 0.1	<0.1	F0 00 100	< 0.1	< 0.1	< 0.1	6.03 ×0.1	< 0.1	< 0.1	× 0.1	c0.1	0.47	0.65	< 0.25	<0.25 <0.25 <0.25
₽₽₽₽	<0.1	< 0.05	< 0.05	< 0.05	<0.005 0.42 0.44	< 0.05	0.15	< 0.05	6.77 <0.05 <0.05	0.05	< 0.05	0.12	<0.05 <0.025 0.03	9.02	60.0	< 0.025	<0.025 <0.025 <0.025
PF8A	< 0.25 < 0.25 < 0.225	< 0.25	< 0.25	< 0.25	×0.25 ×0.25 ×0.25	< 0.25	< 0.25	< 0.25	0.54 <0.25 <0.25	< 0.25	< 0.25	< 0.25	62.25 62.1	0.18	< 0.1	<0.1	0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
₽£03 4	90.08	1.75	1.89	1.12	0.08 28.00 38.00 38.00 38.00	0.13	0.62	1.93	0,72 0,72 6,19	0.12	4.	1.02	7 93 93 932 933	0.58	0.26	0.58	25 0 0 17 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
b£02	1,1	139.0	59.0	45.3	483 7.3 267	31.0	20.3	68.4	8.0 6.7 39.8	21.6	45.0	34.2	18.9 22.9	4.8	10.2	74.4	7 7 8 12 8
PFHS	0.06	0.12	0.05	90.0	008 008 008	< 0.05	< 0.05	0.13	<0.05 <0.05 0.11	90.02	0.13	90.0 >	< 0.05 < 0.05 < 0.05 < 0.05	< 0.05	< 0.05	< 0.05	<0.05 00 00 00 00 00 00 00 00 00 00 00 00 0
PFB\$	< 0.05	< 0.05	< 0.05	< 0.05	<0.05	< 0.05	< 0.05	< 0.05	<0.05 <0.05 <0.06	< 0.05	< 0.05	c0:0>	<0.25 <0.25 <0.25	< 0.25	< 0.25	< 0.25	60.28 50.28
End Wesding	W93° 00.580: W93° 00.532	W93° 00.475'	W93° 00.475'	W93° 00.475	W93* 00.475 W93* 00.475 W93* 00.475	W93° 00.475'	57,239	57.239	56.370° 56.370° 56.370°	56.370'	55.880	22.880	W92° 55.880' W92° 55.880'	W92° 55.880'	W92° 55.880'	55.880'	56.022 56.022
	W93*	W93	W93°	W93	W93*	W93.	W92°	W92°	W92*	W92°	W92°	764	W9Z°	W92°	W92°!	W92° 55.880	W92° 56.072 W92° 56.072 W92° 56.022
Start Westing	W93° 00.813°	W93° 00.664'	W93" 00.664"	W93" 00.664"	W93* 00 664* W93* 00 664*	W93° 00.664'	W92° 58.180'	W92° 58.180°	W92* 57.877 W92* 57.877	W92° 57.877'	W92° 56.343'	W3Z 30.343	W92" 56.343 W92" 56.343	W92° 56.343°	W92° 56.343'	W92° 56.343'	W92* 56.028 W92* 56.028
Builtholf bn3	N44" 49.790" N44" 49.900"	N44° 49.047'	N44° 49.047'	N44° 49.047	N44* 49.047 N44* 49.047 N44* 49.047	N44° 49.047'	N44° 46.000'	N44° 46.000'	N44" 46.244" N44" 45.244" N44" 46.244"	N44° 46.244'	N44° 46.210°	1444 40.210	N44* 46.210* N44* 46.210* N44* 46.210*	N44° 46.210'	N44° 46.210'	N44° 46.210°	N44° 46,982' N44° 46,982'
Start Northing	N44° 50.286° N44° 50.336	N44° 49 719°	N44° 49.719'	N44° 49,719'	N44° 49,719° N44° 49,719° N44° 49,719°	N44° 49.719'	N44° 46.322'	N44° 46.322'	N44" 46.162 N44" 46.162	N44° 46.162'	N44° 45.972' N44° 45.072'	7.6.7	N44° 45.972 N44° 45.972 N44° 45.972	N44° 45.972'	N44° 45.972'	N44° 45.972'	N44° 46,725° N44° 46,725 N44° 46,725
uny	NA	4	4	4		4	-	-	4 2 2	2	e e	200	C G G	z ص	z ص	z و	4 4 4 5 2 2 2
Кеасһ		7	7	7		7	თ	თ	් වී .	თ	ത ദ	,	တ တ တ	6	6	6	a 9 a
Age (yr)	4 4	4	က	7	4 1 2	7	80	7	7 8 0	4	4 4	-	8 9	5	g	9	
Sample length (whole body, cm)	15	38.5	83	42.5	8 23 25	33	4	18	8 3 8	8	37	3	12 2 8	4	32	37.5	25 4 CD
Sample mass (whole body, g)	68.04	739.36	467.20	1016.05	1038.73 4038.73 476.27	367.41	1106.77	258.55	- 100e 38 - 100e 38	158.76	616.89	00.100	1023 65 698.63	889.04	399 16	557 92	98 98 72 72 57 57 57 57 57 57 57 57 57 57 57 57 57
Таха (соптоп)	Bluegill W bass	W bass	W bass	W bass	W bass	F drum	Sm bass	W bass	Sin bass	Bluegill	W bass	2	Sm bass F drum	F drum	F drum	Wbass	Bluegill F drum
Ol daJ	109FN1	111FN1	112FN1	113FN1	115FM 115FM 116FM	117FN1	119FN1	120FN1	123FN1 124FN1 125FN1	126FN1	127FN1 128FN1		130FN1 131FN1	132FN1	133FN1	134FN1	Tagen (38 Part)
Gl əussīT	109FN 110FN	111FN	112FN	113FN	114FN 115FN 116FN	117FN	119FN	120FN	123FN 124FN 123FN	126FN	127FN 128FN		128FN 130FN 131FN	132FN	133FN	134FN	135FN 137FN
Eield ID		1	112	113	1 70 S	117	119	120	2 a 2	128	127			132	·	¥51	£ 38 15 13 13 13 13 13 13 13 13 13 13 13 13 13

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Table A-1. 3M Analysis of Fish Tissue Samples for PFCs (ND = RL)

: G sunfish
) = dsiJus เ
bass; Greer
e bass = W
n bass; Whit
h bass = Sr
Smallmout
n = F drum;
Freshwater drun
reviations: Fi
Taxa abb

Aodag	1.86	1.46	1.33	1.04	0.99	0.99	1.35	147 119 336	1.79	1.78	2.73	1,07	1.03	0.27	1.52	54(2) 992	897	96.0	3.10
AnU3q	1.90	1.64	1.53	8 2 3	0.92	1,41	1.68	202	1.80	1.33	1.66	\$ # \$	1.10	0.26	1.48	21.8	(83)	0.88	2.26
AGH	4.51	1.73	2.55	85.12 2.67	1.95	2.99	3.90	426 335	3.18	1.33	1.39	2 2 2	1.15	0.54	2.96	60%	3.71	1.33	2.65
PFNA	96.0	0.32	< 0.25	2 3 3	< 0.25	0.28	0.37	g y e	<0.1	<0.1	< 0.1	open	<0.1	0.11	0.42		0.52	< 0.05	0.31
FF0A	< 0.1	<01	< 0.1	\$ \$ \$	× 0.1	× 0.1	< 0.1	5 5 5	< 0.1	<01	< 0.1	\$ \$ \$.	< 0.1	< 0.1	< 0.1	71.0	E0 > 1	< 0.1	<0.1
Адняч	< 0.025	< 0.025	< 0.025	<0.025 <0.025 <0.025	< 0.025	< 0.025	< 0.025	<0.025 <0.025 0.03	< 0.025	< 0.025	< 0.025	<0.075 <0.005 <0.005	< 0.025	< 0.025	< 0.1	<0.1	<0.1	< 0.1	c 01
AxH4q	0.33	0.36	0.79	\$ 60.25 10.00	0.33	< 0.25	0.29	80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 8	< 0.25	< 0.25	< 0.25	<0.25 <0.25 <0.25 <0.25	< 0.25	< 0.25	< 0.25	<0.25	<0.25	< 0.25	< 0.25
A∍d∃q	< 0.025	< 0.025	80.0	<0.025<0.025<0.025	< 0.025	< 0.025	< 0.025	\$ 5 5	< 0.1	< 0.1	< 0.1	10, 10,	< 0.1	< 0.1	< 0.25	< 0.25	<0.25	< 0.25	< 0.25
A839	×01	< 0.1	0.28	619 00	< 0.1	< 0.1	< 0.1	<0.25 <0.25 <0.25	< 0.25	0.30	< 0.25	\$0.25 \$2.00 \$2.00 \$2.00 \$2.00	< 0.25	< 0.25	< 0.25	<0.25	< 0.25	< 0.25	< 0.25
₽FOSA	1.25	0.81	0.42	0 77 2.20 7.70	1.78	0.79	0.61	2. 2. 1. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2.	0.89	4.06	8.54	5 5 5	0.42	0.13	0.94	0.84	984	0.17	0.33
PFOS	112.0	127	215.0	726 7260 55.9	33.0	37.9	49.8	71.4 167.0	48.5	61.2	7.97	77 480 700	15.1	18.3	47.4	55.8	61.3	28.6	35.5
PFHS	0.12	< 0.05	< 0.05	0.13 0.23 0.07	< 0.05	< 0.05	< 0.05	000	0.03	0.03	0.04	000 004 <0.025	< 0.025	0.05	0.13	0.39	9/0	0.27	0.15
PFBS	< 0.25	< 0.25	< 0.25	<0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25 <0.25	< 0.25	< 0.25	< 0.25	0 0 0	< 0.1	<0.1	< 0.1	6 6 10 E	< 0.1	0.13	Œ	MR	, NR	Ä	꽃
End Westing	W92° 55.353'	W92° 55.353'	W92° 55.353°	W92° 54.883° W92° 54.883°	W92° 58.093'	W92° 56,381°	W92° 56.046'	W92° 56.336° W92° 54.306°	W92° 54.306'	W92° 52.438'	W92° 52.438°	W92" 52.438 W92" 52.406 W92" 53.419	W92° 58.093'	W92" 58.093'	W93° 00.780'	W93* 00.780 _±	W93" 00.786"	W93* 00.780*	W93° 01 129'
gnäseW វាសិខ	W92" 55.997	W92° 55.997"	W92° 55.997'	W92* 56.997 W92* 54.805 W92* 54.805	W92* 58.173'	W92° 56.769'	W92° 56.349'	W92* 55.897 W92* 55.048 W82* 35.049	W92° 55.049'	W92° 52.724°	W92° 52.724'	W92" 52.724 W92" 52.724 W92" 53.408	W92° 58.173'	W92* 58.173'	W93° 00.625	W93*00.625	W92*00.625	W93" 00.625'	W93° 01 757'
End Northing	N44" 47 115	N44° 47 115	N44° 47 115'	N44*47.115* N44*46.218 N44*48.218	N44° 46.299	N44° 46.234'	N44° 46.163'	N44° 47,108° N44° 47,025° N44° 47,025°	N44* 47 025'	N44° 46.230'	N44° 46.230'	N44*46.230 N44*46.230 N44*45.914	N44° 46.299'	N44° 46.299'	N44° 52.020°	N44*52.020	N44*52,020*	N44° 52.020'	N44° 53.279°
gnirthoM nst2	N44° 47 011'	N44° 47.011'	N44° 47 011'	N44° 45.430 N44° 46.430	N44° 46.341'	N44° 46.060'	N44° 45.970°	N44" 47.038 N44" 47.103 N44" 47.103	N44* 47 103'	N44° 46.526'	N44° 46.526'	N44° 46.526' N44° 46.526' N44° 46.900	N44° 46.341'	N44° 46.341'	N44° 51.331'	N46551,331"	N44* 51,337*	N44° 51.331'	N44° 53.736'
uny	ν	w	ß	5 8 8	9	∞	တ	9 + 4	4	S	2	v v	12	12	. -			-	-
Кеасh	6	6	6	6 0 0	6	6	თ	(6 2) 2.	0	6	6	2 2 2	6	თ	φ	8	8	9	ĸ
(1V) 9gA	=	80	6	2 2	2	ო	4	8 4	ဖ	က	е	* N F	7	-	4	25	i e	22	11
Sample length (whole body, cm)	43	36.5	37	8 8 8	26	8	38	43.5 35	37	32	34	8 8 8	46	13	35.5	* 1 8	8	83	98
Sample mass (whole body, g)	979.76	739.36	657.71	338 34 34 34 34 34 34 34 34 34 34 34 34 34	208.65	598.74	458.13	775.75 1065.94 607.81	566.99	639.57	458.13	276.68 417.30	1256.45	36.29	576.06	866.78	598.74	449.06	807.39
Таха (соттоп)	W bass	F drum	F drum	F dum W bass W bass	W bass	W bass	W bass	W basis Sm basis Sm basis	W bass	Sm bass	Sm bass	Sm basss Sm basss W bass	Sm bass	Bluegill	W bass	Whas	Wbass	F drum	F drum
Cab ID	138FN1	140FN1	141FN1	143FN 143FN	145FN1	146FN1	148FN1	149FN1 ESFNH ESFNH	153FN1	158FN1	159FN1	160FN1 161FN1 162FN1	163FN1	164FN1	165FN1	166FM	1/1-881	170FN1	171FN1
Gl eussi∏	138FN	140FN	141FN	143FN 143FN	145FN	146FN	148FN	189EN 150EN	153FN	158FN	159FN	160FN 162FN	163FN	164FN	165FN	166FN	168FN	170FN	171FN
Field ID	138	140	141	25 (84 4)	145	146	148	3 8 E	<u>र</u>	158	159	8. <u>5</u> . 2	163	164	165	391	82	170	171

Table A-1. 3M Analysis of Fish Tissue Samples for PFCs (ND = RL)

Taxa abbreviations: Freshwater drum = F drum; Smallmouth bass = Sm bass; White bass = W bass; Green sunfish = G sunfish

Ao039		2.92	1. 0 8. 86	69	1.77	132	: ;	2.03 7.03 6.38	-8	1.39	1.05		0.28	a . 8	6.88	1.08	1.47	131	E 1	Ž	3	1.17	0.51	0.38	0.37
A⊓U∃q		2.19	25 8g	1,02	1.26	1.38	;		85.7	1.98	1.24	36.0	0.35	0.85	123	1.25	1.28	161	75.	218	7. 81	0.95	0.61	0.54	0.69
₽ED₩		3.76	3.07	88	1.97	2.00	;	2 21	2 .	2.67	1.16	270	/*'0	3 2	2.58	3.36	1.79	2.39	43	8 !	7.75	1.22	0.99	1.15	232
PFNA		0.20	8 80 4	800	< 0.05	0.08	900	900, 900,	900	0.59	0.04	900	\$	0.36	Ş	0.39	0.21	0.03	0.57		3	0.28	60.0	90:0	0.27
PF0A		v 0.1	20 TO TO	5	<01	<0.1	,	5 5	÷.	0.43	<0.1	V 0.1		- - -	₹0.1	0.20	0.27	0.18	<0.1		Ž.	0.11	0.12	<0.1	0.16
AqH79	į	v 0.1	10° 50°	- - -	<0.1	< 0.1	,	5 5.	Ę	< 0.05	< 0.05	< 0.05	200	2002 2005	\$000	< 0.05	< 0.05	<0.05	×0.00×	60.06 60.00		< 0.05	< 0.05	0.07	<0.05
AxH ₇ q	100	\$10.20 \$10.20	\$0.25 \$0.25 \$0.25	3	< 0.25	< 0.25	<0.25	<0.25 <0.25	< 0.25	< 0.25	< 0.25	< 0.25		< 0.25	8 8	< 0.25	< 0.25	< 0.25		S #	¥	< 0.25	< 0.25	< 0.25	<0.25
A∍q∃q	36.07	27.0	60 % 60 % 60 % 60 % 60 % 60 % 60 % 60 %	3	< 0.25	< 0.25	< 0.25	<0.25 <0.25	< 0.25	< 0.25	< 0.25	< 0.25			<0.25	<0.25	< 0.25	< 0.25		0 0 0 0 0 0		< 0.25	<0.25	< 0.25	<0.25
PFBA	× 0.25	300	8 8 8 8 8	3	< 0.25	< 0.25	< 0.25	ل ر ۲۰	<0.25	< 0.25	< 0.25	< 0.25			< 0.25	< 0.25	< 0.25	< 0.25	His			< 0.25	< 0.25 <	< 0.25 <	<025
PFOSA	0.25		87 BB		0.38	0.47	0.68		0.72	0.45	0.52 <	> 0.03	Ž.		0.74	0.73 <	0.24 <	0.42 <	· .			0.17 <(0.06	0.17 <(800
PFOS	18.5	}	88.7 86.7		28.6	35.3	30.1		33.7	27.5	19.2	7.9			516.0	113.0 0	41.9 0	46.1 0	972			0 5.07	22.2 0.	34.9 0.	65.4 0.
PFHS	0.1		2 6 §		< 0.1	< 0.1	< 0.1	To.	0.18	0.18	< 0.05	< 0.05	900	9000	900	< 0.05	< 0.05	< 0.05	90.00		M)	000	< 0.05	0.09	
PFBS	景		, <u>F</u>		NR.	¥	Ϋ́ Ϋ́	¥ ¥	Œ	< 0.05	> 0:05 >	< 0.05	800		<0.005	< 0.05	< 0.05	< 0.05 <	<0.05 20.05 20.05	k.	V 2002			< 0.05	<0.06 0
	.129		01.129 01.129		129'	129'	129,	& 2	129				725.00												
End Westing	W93* 01.129		0.26M		W93° 01 129'	W93° 01 129	W93° 01 129	W93* D1.129	W93° 01.129	W93° 00,922	W93* 00.922"	W93° 00.922	W83* 00	W93* 00.922	W93*00.922	W93° 00.922	W93° 00 922	W93° 00.922	W93° 01.769	W93* 01.769	W93° 01 769	2	W93° 01 769	W93° 01 769′	W93° O1.769'
gaitseW tist2	W93° 01.757		W93" 01.757 W93" 01.757		W93° 01 757'	W93° 01.757	W93° 01 757'	W93° 01757	W93" 01.757	W93" 01.069"	W93° 01.069	W93" 01.069"	W93" 01.069"	W93* 01.058	W93* 01.069*	W93° 01.069'	W93° 01.069°	W93* 01.069	W93" 02.478	W93* 02.478*	W93° 02 478'		W93° 02.478'	W93° 02.478'	W93*02478
End Morthing	N44° 53.279'		N44°53278 N44°53279 N44°53278		N44° 53,279'	N44° 53.279'	N44° 53.279'	N44" 53.279 N44" 53.279	N44°53.279	N44° 53.066'	N44° 53.066'	N44° 53.066'	N44" 53.066"	8	N44° 53,066	N44° 53.066°	N44° 53.066'	N44° 53.066'	N44° 53.732 N44° 53.732		N44° 53.732°		සු	N44° 53.732'	N44*53,732*
gnidhold hat2	N44° 53.736'		N44" 53.736 N44" 53.736		N44° 53.736'	N44° 53.736°	N44° 53.736'	N44" 53.736' N44" 53.736'	N44°53.736	N44° 53.430°	N44° 53.430′	N44° 53.430°	N44*53430*	N44* 53 430	N44*53.430	N44° 53.430'	N44° 53.430'	N44° 53.430'	N44° 54.153 V44° 54.153	N44° 54, 153'	N44° 54.153'	200	N44* 54.153	N44° 54.153	N44°54.153
unу	-			X		-			.	7	2	7	2		2	2	7	2			4			4	4
Reach	22		6 ° 0 ° 0	SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS	လ	40	2	6. Lø	S	s.	ß	တ	S	, o	9	2	S	2	9.00) - -	5	ч	n i	6	S.
(1y) egA	24		▼	S. 1999. Taleston	က	2	4			5	2	2) د برای	. NAME	œ	S	æ	e e	8	7	·	v ;	W.	<u>.</u>
Sample length (whole body, cm	49		% \$2.2 % \$2.2	C. C	ર્સ	27	33			\$	82	15	18.5		7.	33	æ	32	F . 8	æ.	88	13.5	5.5	C .	E .
Sample mass (whole body, g)	1505.93		208.65 268.55		36/41	258.55	508.02	426.38 27.22	18 18 18 18	1197.48	349.27	77.11	136.08	309,16	01.000	508.02	449.06	498.95	50805 508.02	748.43	639.57	58 97	5 22	14.07	7.2
Taxa (common)	F drum		W bass	Č	SSED INC	Sm bass	Sm bass	Sur bess	illőenia .	Engle L	Sm bass	Bluegill	Bleegill	Edum	5	H dra	F drum	Sm bass	W bass	F dum	F drum	Bluedill	,	iii Bana	Sillegill.
G! d≊J	172FN1		175EN 1	477774	Z.	178FN1	179FN1	NEO81 INTIBI			186FN1	187FN1	188FN1	1895NF		LN-II-	192FN1	193FN1	194FN 196FN	197FN1	198FN1	199FN1	200EN4		201FN1
Ol suzziT	172FN		776FN	142EN		178FN	179FN	180FN (181FN	JOSEN 4	<u> </u>	186FN	187FN	.188FN	28 N		N. I	N-126L	193FN	194FN (195FN	197FN	198FN	199FN			Y.
GI bləi∓	172		4 277 371	177	=	178	179	8 ₽ 8	3 2	3 8	<u>8</u>	18/	8	8 8		<u>.</u>	Z6. 5	55	<u>참</u> 왕		198	99) 5

Table A-1. 3M Analysis of Fish Tissue Samples for PFCs (ND = RL)

ĺ	AoG 1 9	1.28	1.50	0.13	1.27	0.55 1.28 0.85	1.29	0.90	0.95	2 2 2	1.01	1.57	0.88	77 ° 77 ° 77 ° 77 ° 77 ° 77 ° 77 ° 77	1.79	1,47	#1	
	PFUnA	8 E	1.39	0.56	1.62	2 7 3 2 3	1.23	0.98	1.22	2 2 2	1.18	1.49	99.0	5 2 2	1.81	1.21	2	
	₽₽₽₽	0.75	1.63	1.21	3.38	j 8 j	1.47	1.18	1.52	4 8 8	1.41	3.10	0.83	0.80 1.58 2.02	3.21	2.00	220	2 2 2
	ANA	0.03	< 0.025	< 0.05	99'0	0.14 <0.005 <0.005	< 0.05	< 0.05	< 0.05	0.89	< 0.05	0.55	0.15	0005	< 0.05	90.0	\$000°	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	AO∃q	<0.1	< 0.1	< 0.1	< 0.1	9. 2. 2	< 0.1	< 0.1	< 0.1	5 5 5 V	< 0.1	× 0.1	< 0.1	5 5 5	< 0.1	< 0.1	48.1	a v v
	AqHaq	<0.005 <0.005	< 0.05	< 0.25	< 0.25	< 0.25< 0.25	< 0.25	< 0.25	< 0.25	*0.25 *0.25 *0.25	< 0.25	< 0.25	< 0.25	<0.25 <0.25 <0.25	< 0.25	< 0.25	, 80.0	900 × 0000 ×
sunfish	AxH3q	< 0.25	< 0.25	< 0.25	< 0.25	300 HBHR 80 S	< 0.25	< 0.25	< 0.25	\$0.25 \$0.25 \$0.25	< 0.25	< 0.25	< 0.25	<0.28 6.03 6.03 6.03	< 0.25	< 0.25	1	5 6 5
e G su	P⊧peA	7.77 *0.28	< 0.25	< 0.25	< 0.25	\$0.50 \$0.38 \$0.38	< 0.25	0.42	0.28	\$20.28 \$0.28	< 0.25	< 0.25	< 0.25	\$2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	< 0.25	< 0.25	48.4	5 8 8
Green sunfish	₽ 84	<0.25	< 0.25	< 0.35	1.11	<0.35	< 0.35	< 0.35	< 0.35	80 80 00 0.30 0.30	< 0.35	< 0.35	< 0.35	8. 8. 8. 8. 8. 8. 8. 8. 8. 8. 8. 8. 8. 8	< 0.35	< 0.35	+0+	00 00 00 00 00 00 00 00 00 00 00 00 00
reen (ASO74	0.76 0.33	0.59	0.03	0.88	0.03	0.39	0.40	0.29	75 00 00	0.39	99.0	0.07	0.07	0.40	0.51	**	F E 3
bass; G	PFOS	4.9	18.7	48.8	48.6	8 602 802 802	28.6	29.6	33.2	ž ž 3	20.5	48.9	11.0	37.78	44.2	23.5	198	3 3 9
≯	SH±d	<.005 <.005	< 0.05	90:0	< 0.05	8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	< 0.05	< 0.05	< 0.05	600°	< 0.05	20.0	< 0.05	<0.05 <0.05	< 0.05	< 0.05	270	
nite bas	PFBS	90°0 >	< 0.05	< 0.25	< 0.25	800 800 800 800	< 0.25	< 0.25	< 0.25	40.25 40.25 40.25	< 0.25	< 0.25	< 0.25	\$0.55 \$0.25 \$0.25 \$0.25	< 0.25	< 0.25	×0.00	8000 8000 8000 8000
Sm bass; White bass	End Westing	W93* 01,769*	W93° 01 769'	W93° 01 014'	W93° 00.606'	W83° 00.606 W83° 00.606	W93° 00.606'	W93" 00.606"	W93° 00.606'	W93° CO 647 W93° CO 647	W93° 00.461'	W93° 00.461'	W93" 00.461"	W93* 01.014* W93* 04.305	W93° 04.305'	W93° 04.305'	WS2 04.305	W93" 04.305 W93" 04.305 W93" 04.305
- II	gnitseW hat2	W93° 02.478 W93° 02.478	W93° 02.478'	W93* 01.079	W93" 00.857"	W93° 00.857 W93° 00.857	W93° 00.857'	W93° 00.857'	W93° 00.857'	WEG: 00.663 Weg: 00.658 Weg: 00.628	W93° 00.528'	W93° 00.528°	W93° 00.528'	W93" 01.021" W93" 01.021" W93" 04.519	W93° 04.519°	W93° 04.519'	WELT DE 519	WBG* 04.519 WBG* 04.519 WBG* 04.519
mallmouth bass	End Morthing	N4*53.72 N4*53.72	N44" 53.732	N44" 52.931'	N44° 52 171'	NAP 52.171 NAP 52.171 NAV 52.171	N44° 52.171'	N44° 52.171'	N44° 52.171'	N44*51.810 N44*51.810 N44*51.855	N44" 51,655	N44" 51.655	N44* 51.655	N44° 52.675 N44° 52.675 N44° 56.886	N44° 56.885'	N44° 56.885'	NAT. 35 BBS.	**************************************
E drum; Small	gnidhoM hat2	N44" 54,153" N44" 54,153"	N44° 54.153'	N44° 53.048'	N44° 52.916'	N44° 52.916° N44° 52.916° N44° 52.916°	N44° 52.916'	N44° 52.916'	N44° 52.916'	N44" 52.011" N44" 52.011" 'N44" 51.916	N44° 51 916'	N44° 51.916'	N44° 51.916'	N44" 52.865 N44" 52.865	N44° 56 797	N44° 56.797	MAY 55 757	N44" 56.797
S ES	uny	4 /4	4	so.	ო	m 6 m	3	ю	က	4. 4. 9	2	2	2	6 9 -	-	-	**	
ior rr iter dr	Кеасһ	ما م	5	ď	9	တ တိ် တ	9	9	9	ω & Φ	-1X	ဖ	9	O Ø 7	4	4	4	
Samples for Pros Freshwater drum	(1 y) 9BA	2 2	H,	ø	4	T. 00 N	က	2	2	9 7 7	.H	Ś	7	- K	5	4	di	
sue sa ons: Fi	Sample length (whole body, cm)	11.	4	15.5	37		ਲ	54	24		. 8	8	8		41	8	Ħ	5 5 9
or Fish Tissue : abbreviations:	Sample mass (whole body, g)	27.22	607.81	11 11	707.60	18 (4 467.20 199.58	557 92	199.58	217 72	51.833 675.96 875.96	326.59	716.68	625.96	86.18 476.27 607.81	521.63	317,51	#7.63	# 199.58 372.05 290.30
. 3M Analysis of Fish Tissue Samples for FFCs (ND = NL). Taxa abbreviations: Freshwater drum = F drum;	(nommos) sxsT	G sumfah Sm bass	Sm bass	Bluegill	W bass	Bluegill Sm bass Sm bass Sm bass Sm	Smbass	Sm bass	Sm bass	W bass W bass	Sm bass	W bass	F drum	Bitegill Sm bass	Sm bass	Sm bass		W bass W bass
SM Ana	GI de⊿	ZOZENÍ 203ENÍ	204FN1	205FN1	206FN1	ZOBENI ZOBENI	211FN1	212FN1	213FN1	Z14FNI Z15FN1	217FN1	218FN1	219FN1	ZOFNI 2ZIFNI ZZZFNI	223FN1	224FN1	PS6FT	223FN1 229FN1 220FN1
able A-1.	Ol euszi∏	202FN	204FN	205FN	SOFN	207FN 208FN 209FN	211FN	212FN	213FN	ZEEN	217FN	218FN	219FN	220FN 223FN	223FN	224FN	¥-1982	2885 N
<u>a</u>	Field ID	202	Š	202	300		211	212	213	2 2 2	217	218	219	8 8 8	223	77	*	8 8 8

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Table A-1. 3M Analysis of Fish Tissue Samples for PFCs (ND = RL)

Taxa abbreviations: Freshwater drum = F drum; Smallmouth bass = Sm bass; White bass = W bass; Green sunfish = G sunfish

Ao044	1.21	1.39	0.25	5 8 8	0.83	0.61	0.48	97.0 9.85	1.73	0.49	1.68	1.38	1.26	1.44	92.0	27.45	1.55	1.84
AnUaq	1.46	1.77	0.57	8 8 8 8 8	0.68	0.62	0.61	0 0 0 0 0 0	1.26	0.62	2.11	3 4 8	0.74	1.67	0.65		1.96	2.07
₽Ū∃d	3.25	4.00	1.07	2 2 8	0.75	0.71	0.84	8 5 5	1.50	1.35	4.00	g j g	0.00	3.15	0.94	8 8	3.89	4.03
ANAq	0.92	08.0	< 0.05	\$000	91.0	< 0.05	< 0.05	900	< 0.05	0.15	0.85	90°0 90°0	0.15	0.57	0.33	00° 0° 0° 0° 0° 0° 0° 0° 0° 0° 0° 0° 0°	0.71	0.45
₽FOA	< 0.1	<0.1	* 0.1	× 01 × 01 × 01 × 01 × 01 × 01 × 01 × 01	< 0.1	< 0.1	< 0.1	, v v v v	< 0.05	< 0.05	< 0.05	<0.05 <0.05 <0.05	90:0	< 0.05	< 0.05	<0.00 <0.00 <0.00 <0.00	< 0.05	< 0.05
AqHaq	< 0.05	< 0.05	< 0.05	8 8 6	< 0.05	< 0.05	< 0.05	005 005 006 006	< 0.05	< 0.05	< 0.05	\$000 \$000 \$000 \$000	< 0.05	< 0.05	< 0.05	8 8 8	< 0.05	< 0.05
AxH4q	<0.1	<0.1	< 0.1		< 0.1	< 0.1	< 0.1	Sample St.	< 0.5	< 0.5	< 0.5	19 19 19	< 0.5	< 0.5	< 0.5	9 9 9	< 0.5	< 0.5
₽₽₽₽	0.11	< 0.1	< 0.1	<u>\$</u> - \$ - \$	< 0.1	0.11	0.14	* 10° 12°	0.41	< 0.25	< 0.25	<0.25 <0.25	< 0.25	< 0.25	< 0.25	\$0.05 \$0.05 \$0.05	< 0.25	< 0.25
₽₽₽A	< 0.1	0.12	< 0.1	40. 40. co.	0.24	<0.1	< 0.1	6 10 00	<10	<1.0	< 1.0	2 t 0	< 1.0	<10	< 1.0	, <u>,</u> ,	< 1.0	v 1.0
₽FOSA	1.06	0.76	0.05	900	0.08	0.11	0.04	0.00	0.60	0.05	5.28	0.08 0.76	0.17	1.03	0.10	0.10	0.73	0.79
PFOS	59.2	64.7	52.5	2 2 S	15.0	23.5	27.9	¥ \$ %	18.6	66.1	80.8	* * * * * * * * * * * * * * * * * * *	3.2	63.3	39.5	\$ \$ \$	68.7	64.4
PFHS	< 0.25	< 0.25	< 0.25	\$0.5 \$2.05 \$3.05 \$0.05	< 0.25	< 0.25	< 0.25	\$2 - \$2 \$3 \$2 - \$2 \$3	< 0.05	0.18	0.14	90 90 90 90 90 90 90 90 90	< 0.05	< 0.05	< 0.05	90° 80° 80° 80°	< 0.05	< 0.05
PFBS	< 0.05	< 0.05	< 0.05	<0.00 × 0	< 0.05	< 0.05	< 0.05	90°0 40°0 70°0 70°0 70°0 70°0 70°0 70°0 7	< 0.05	< 0.05	< 0.05	* * * * * * * * * * * * * * * * * * *	< 0.05	< 0.05	< 0.05	5000 5000 5000 5000 5000 5000 5000 500	< 0.05	< 0.05
End Westing	W93° 04.305'	W93° 04.305'	W93° 04.305'	W85° D4.305 W93° C4.305 W83° C4.305	W93° 04.305'	W93° 04,305'	W93° 03.620°	W93° 03.620° W93° 03.620°	W93° 03.620'	W93* 03.620°	W93° 03.620'	W93° 03.620 W93° 03.290 W93° 03.290°	W93° 03.290°	W93° 03,290'	W93° 03.132'	W93° 03.132 W93° 02.999 W93° 02.999	W93° 04.785	W93° 04.785
Start Westing	W93° 04.519'	W93° 04.519'	W93° 04.519'	W93 04.519 W93 04.519	W93° 04.519'	W93° 04.519°	W93° 04.049°	W93" 04.049 W93" 04.049	W93* 04.049'	W93° 04.049'	W93* 04.049*	W93* 04.049	W93° 03.592'	W93° 03.592'	W93° 03.148'	W93* 03 148 W93* 02 890 W93* 02 890	W93° 04.887'	W93° 04.887'
End Morthing	N44* 56.885	N44° 56.885'	N44° 56.885'	N44" 56.885 N44" 56.885 N44" 56.885	N44° 56,885	N44° 56.885	N44" 56.553'	28. 28. 28. 28. 28. 28. 28. 28. 28. 28.	N44° 56.553'	N44" 56.553'	N44° 56.553°	N4*8552 N4*8522 N4*38522	N44° 56.522'	N44° 56.522'	N44° 56.035'	N44*58.035 N44*55.68 N44*56.68	N44° 56.834'	N44° 56.834'
Start Northing	N44° 56.797'	N44° 56.797'	N44° 56.797	N44° 56.797* N44° 56.797* N44° 56.797	N44° 56.797	N44° 56.797'	N44° 56.848'	N44° 56.848 N44° 56.848 N44° 56.848	N44° 56.848°	N44° 56.848°	N44° 56.848'	N44" 56.848" N44" 56.670"	N44° 56.670'	N44° 56.670°	N44° 56.102'	N44° 56.102 N44° 56.805 HN44° 56.805	N44* 56.795'	N44° 56.795'
Вил	-	-	-		-	-	7	0 0 0	2	2	5	~ e ⊩e	ო	က	4	4 2 6	4	4
Кеасћ	4	4	4		4	4	4	4 4	4	4	4	- 4 - 4 - 4 - 4 - 4 - 4	4	4	4		က	ო
(1y) egA	5	80	00	1 1 1 1	-	ო	4	4	ო	2	5	44 49 V	13	5	9	100 AB. 100	22	7
Sample length (whole body, cm)	37.5	38.5	16.5	9 2 2 S	10.5	10	18	\$ 2 S	315	55	88	8 8 4	4	æ	88		35.5	æ
Sample mass (whole body, 9)	335.66	362.87	36.29	28.239 18.14 18.51	13.61	9.07	63.50	7722 722 861	222.26	22.68	367.41	353.80	508.02	172.37	1238.31	11486	299.37	367.41
Таха (сопппол)	W bass	W bass	Bhegill	Bitegili Bitegili	Bluegill	G sunfish	Bluegill	Bregille Bregille	Sm bass	Bluegill	W bass	W bass Sm bass:	F drum	W bass	F drum	Found From From From From From From From From	W bass	W bass
Gl dεJ	231FN1	232FN1	234FN1	235FNI 238FNI 237FNI	238FN1	239FN1	240FN1	24FN1 242FN1 243FN1	246FN1	247FN1	248FN1	249FN1 250FN1 251FN1	252FN1	253FN1	254FN1	25FNI 27FNI 288FNI	259FN1	260FN1
Ol eu≳síT	231FN	232FN	234FN	236FN 238FN 237FN	238FN	239FN	240FN	24fFN 242FN 243FN	246FN	247FN	248FN	249FN 250FN 251FN	252FN	253FN	254FN	28 FN 58 58 FN	259FN	260FN
Gi bişi7	231	232	234	23/2 23	882	539	240	E 8 8	246	247	248	25 25 ES	252	253	524	% LS 8%	529	260

Table A-1. 3M Analysis of Fish Tissue Samples for PFCs (ND = RL)

		ı													* AT -				
	₽od⊣q	09:0	178 108 177	0.58	1.24	1.98	0.75 0.83 0.84	0.63	1.49	0.50	313	1.06	1.67	1.14	80 89	2	0.53	2.24	77.
	AnU7q	0.75	15 12 20 2 20 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.64	1.45	1.29	600 00 THE	0.51	1.66	0.69	2.17	1 19	1.88	1.22	84, 10 21 10 21	3	0.50	1.95	88
	₩Q∄d	1.34	2 2 3	96.0	2.23	1.26	5 5 5	0.53	1.64	1.76	3.87 0.63 2.72	2.92	3.84	1.80	15 2	22	0.58	3.05	346
	₩∃₫	0.24	~0.05 0.75 0.87	0.36	< 0.05	0.10	0.73	< 0.05	< 0.05	0.26	0.78 0.05 0.05	< 0.05	< 0.05	< 0.05	<0.05 <0.05 <0.1	1.0	80.0	0.54	0.57
	Vall	< 0.05		< 0.25	< 0.25	< 0.25	\$0.28 \$2.03 \$2.05	< 0.25	< 0.25	< 0.25	60.25 60.25 70.25	< 0.25	< 0.25	< 0.25			92		
	AO19															92	< 0.05	0.11	< 0.05
	AqH∃q	< 0.05	<0.05 <0.06 <0.06	< 0.05	< 0.05	< 0.05	< 0.05 < 0.05 < 0.05	< 0.05	< 0.05	< 0.05	<0.05 <0.05 <0.05	< 0.05	< 0.05	< 0.05	x 0.05 × 0.05 × 0.25	48.28 48.28	< 0.05	< 0.05	< 0.05
sunfish	AxH14	< 0.5	<0.5 <0.5 <0.25	< 0.25	< 0.25	< 0.25	40.25 60.25 82.85	< 0.25	< 0.25	< 0.25	< 0.25< 0.25< 0.25	< 0.25	< 0.25	< 0.25	<0.25 <0.25 <0.1	4	ğ	< 0.25	< 0.25
= G su	A₅q∓q	< 0.25	<0.25 <0.25 <0.25	< 0.25	< 0.25	< 0.25	<0.25 <0.25 <0.25	< 0.25	< 0.25	< 0.25	0.250.250.25	< 0.25	< 0.25	< 0.25	<0.25 <0.25 <0.35	₩. ₩	Ä	< 0.1	0.40
	₽FBA	<1.0	35 U	< 0.35	< 0.35	< 0.35	\$0.00 \$0.00	< 0.35	< 0.35	< 0.35	\$0.86 \$0.08 \$0.08	< 0.35	< 0.35	< 0.35		##	Ä	4.59	-0.25
Green sunfish	Vada																		
	Asoqq	0.34	0.75 0.75 0.56	0.07	0.27	0.23	0.00	91.0	0.25	0.08	8 8 8	0.33	0.29	0.26	**************************************		0.09	0.23	988
W bass;	PF0S	20.4	74 gg 52	24.2	20.3	12.8	40.3 30.8 273.0	4.9	19.5	44.9	2 0 E	47.5	46.1	27.1	14.9	ŧ	16.4	105.0	3
- 11	SH±d	< 0.05	800. 800. 100.	<0.1	< 0.1	<01	5 5 €	< 0.1	< 0.1	< 0.1	ē ē ē	< 0.1	<0.1	< 0.1	<0.1 <0.25	\$ Q	< 0.25	0.21	0,43
White bass	PFBS	< 0.05	<0.05 <0.05 <0.05	<0.1	< 0.1	< 0.1	20 % 20 %	< 0.1	<0.1	< 0.1	9 5 6	< 0.1	< 0.1	<0.1	60.11 60.71 60.25	\$2.0°	< 0.25	< 0.25	<0.25
; Whi				,886	88	/30,	2 2	348,	18.	361.		.986	,986	.96			_		
Sm bass;	End Westing	W93° 04.785	W83" 04.785 W83" 06.5/7 W83" 08.5/7	W93* 11.988	W93" 11.988	W93" 11 730'	W93° 10.678 W93° 10.577	W93° 09.348	W93" 09.348'	W93° 08.361	W93* OB.361 W93* OB.361 W93* O7.886	W93° 07 886	W93° 07.886	W93° 07.496	W93° 07.496 W93° 07.496 W93° 07.496	W95 - 07.450	W93° 07.496	W93" 00.585	W93" 00.585
u		.887	# £ £	.7.16	.226:	.106'	*	.812	.812'	_		,260'	.260	.872		24	.872	:683	والزو
nouth bass	Start Westing	W93° 04.887	W93* 04 887 W93* 06.773 W93* 06.773	W93° 11 972	W93° 11.972'	W93° 12.106'	W93" 1 361 W93" 1 361	W93* 09.812	W93° 09.812'	W93° 08.835	W93" 08 835 W93" 08 835	W93° 08.260	W93° 08.260°	W93° 07.872'	W93° 07.872 W93° 07.872 W93° 07.872	WEST 07.872	W93° 07.872	W93° 00.683°	W93° 00 683°
mouth	ถินแนวเอม ทน:2	56.834"	% 834 % 675 % 676	54.567	54.567	54.345	28.54 28.57 28.57	53.833	33.833	54.205	54,205 54,205 54,879	4.879	54.879"	55.337	5337 5337	100	55.337"	19 284"	9.284
Small	adital bad	N44* 5	A A	N44° 5	N44° 5	N44°	支支支	N44° 5	N44° 5	N44° 5	1 1 1	N44°5	N44°.5	N44°	1 1 I	NEE	N44° 5	N44° 4	Nata A
drum; Small	gnidhoM hat2	. 56.795	44.88.39. 708.88.34.	N44° 54.735	N44° 54.735	N44° 54 711'	53.88.5 53.88.5 5.88.5	N44° 53.661'	N44° 53.661'	N44° 53.878'	N44° 52.878 N44° 53.878 N44° 54.265	N44° 54.265'	N44° 54.265'	N44° 55.094"	N44" 55.094" N44" 55.094"	NAM" SS 1794"	N44° 55.094'	N44° 49.797'	N44° 49,797
П		N44	j j j	N44	N44	N44	1 1 1	N44	N44.	N44	<u> </u>	N44	N44	N44	E E E	NAME OF TAXABLE PARTY.	N44	A44	7
drum	gesch Resch	9 6	16 6 6	5	5	1 6	2 8 8	2 4	2 4	2 5	2 2 2	2 6	2 6	2 7		2 7	2 7	7 5	2
water													•				•		
Fresh	(1y) egA	2	E S B	7	в	17	α <u>α</u> 2	2	ю	ις.	7 7	2	2	9		4	2	17	2
ons:	Sample length (whole body, cm)	31.5	R & &	ਲ	35	\$	8 8 B	83	83	26.5	8 8 2	24	56	88	25 S	12	91	39.5	37
Taxa abbreviations: Freshwater drum	Sample mass (whole body, g)	208.65	28555 289,555 3784,16	185.97	240.40	439.98	231.12 258.55 199.58	199.58	244.94	86.18	204.72 326.58 72.54	90.72	131.54	385.55	353 226 80 353 80	15 ES	49.90	358,34	276.69
a abbı	Taxa (common)	pass	Sm bass W bass	F drum	Sm bass	F drum		Sm bass	Sm bass	F drum	Adum Muhass Santass	Sm bass	Smbass	Sm bass	Sm bass: Sm bass	Sm base	Bluegill	F drum	W base
Tax	,,	×																	1 a 4
	T ^S P ID	261FN1	262FN1	266FN1	267FN1	268FN1	2695N1 2705N1 2715N1	272FN1	273FN1	274FN1	276FN1 277FN1 278FN1	279FN1	280FN1	281FN1	2885 N 2885 N 2885 N		287FN1	288FN1	289FN1
	∐ sussi ⊺	261FN	262FN 263FN 264FN	266FN	267FN	268FN	ZOEN.	272FN	273FN	274FN	276N 277FN 278FN	279FN	280FN	281FN	282FN 283FN 285FN	M1200	287FN	288FN	289FN
	Field ID	261	\$ 8 \$	566	267	568	2 8 E	272	273	274	276	279	780	281	8 8 8 8 8	4	287	588	582

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Table A-1.3M Analysis of Fish Tissue Samples for PFCs (ND = RL)

Taxa abbreviations: Freshwater drum = F drum; Smallmouth bass = Sm bass; White bass = W bass; Green sunfish = G sunfish

			_			_		_			_	_		_		_																	
Aod∃q	87.7	1.27	1.13	1.06	0.36	0.19	0.35	0.33	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.42		0.79	7.52 2.62 0.69	0.64	0.76	0.34	0.60 0.60																
AnU∃4	2 2	1.45	1.08	1.24	7. 92 9. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5.	0.24	0.40	0.29	0.38 1.10	1.83	1.71	0.88	3 3 3	0.53	0,69	0:30	067 067 104																
A 0∃9	7.68	2.22	1.34	2.08	0.75 0.38	0.32	0.64	0.32	25. T. 22.	3.55	3.50	1.01	2	0.92	0.80	0.44	5 15 15																
AN 34	5 -0	< 0.1	< 0.1	<0.1	0.00	< 0.1	< 0.1	< 0.1	0 0 2	0.73	0.59	<0.05	\$00° 00° 00° 00° 00° 00° 00° 00° 00° 00°	60.0	< 0.05	< 0.05	2008 2005																
₽FOA	<0.25 <0.25 <0.25	< 0.25	< 0.25	< 0.25	<0.25 <0.25 <0.25	0.31	< 0.25	< 0.25	*023 *023 *023	0.19	× 0.1	< 0.1	\$ 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	< 0.1	< 0.1	< 0.1	V V V																
AqH79	<0.25 <0.25	< 0.25	< 0.25	< 0.25	\$ \$ \$ \$ \$ \$	< 0.25	< 0.25	< 0.25	<0.25 <0.25 <0.25	9.05	< 0.05	v 0.05	40.05 40.05 40.05	< 0.05	< 0.05	< 0.05	<0.05 <0.05 <0.05																
AxH49	<0.1	< 0.1	0.11	< 0.1	0 0 5	< 0.1	< 0.1	< 0.1	0 0 0 8	< 0.05	70.0	0.18	<0.05 <0.05 <0.005	< 0.05	0.09	< 0.05	\$0.05 77.0 \$0.05																
Aøq∓q	< 0.35	< 0.35	< 0.35	< 0.35	* 03 * 50 * 50 * 50 * 50 * 50 * 50 * 50	< 0.35	< 0.35	< 0.35	\$ \$ \$ \$ \$ 35 \$	< 0.1	¢0.1	0.17	92 9 12 0 24 0	< 0.1	< 0.1	<01	\$ \$																
₽FBA	<0.25	< 0.1	× 0.1	< 0.1	0.40 0.70 0.70	< 0.1	0.21	< 0.1	25	1.40	< 0.5	c.0 >	0.50.50.50.5	2.63	< 0.5	< 0.5	20 20 2 20 20 2 20 20 2																
PF05A	0.88	0.26	0.20	0.25	0.05	0.04	0.04	0.03	90 0 0 62 23 26	0.71	2.02	67.0	0.27 0.29 0.29	0.07	90.0	0.04	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0																
PFOS	68.0 62.3	39.9	27.3	47.5	2 2 3 E	3.6	11.2	11.2	723 36.8 35.7	49.9	65.1	19.1	30.5	21.5	22.5	16.4	20 170 100 170																
PFHS	<025 <025	< 0.25	< 0.25	< 0.25	× 0.25 × 0.25 × 0.25	< 0.25	< 0.25	< 0.25	<0.25 <0.25 <0.25	< 0.05	< 0.05	cn:0 >	× 0.05	< 0.05	< 0.05	< 0.05	<0.05 <0.05 <0.05																
PFBS	<0.25	< 0.25	< 0.25	< 0.25	<0.25 <0.25	< 0.25	< 0.25	< 0.25	< 0.25 < 0.25 < 0.25	< 0.05	< 0.05	90.00	<000 <000 <000 <000 <000 <000 <000 <00	< 0.05	< 0.05	< 0.05	<a 00.585<="" href="https://www.new.new.new.new.new.new.new.new.new.</td></tr><tr><td>End Westing</td><td>W93" td=""><td>W93° 00,585'</td><td>W93° 00.585'</td><td>W93° 00.585</td><td>W93° 00.585 W93° 00.585</td><td>W93° 00.585'</td><td>W93° 00.585</td><td>W93" 00.585'</td><td>W93° 00.585 W93° 00.429</td><td>W93° 01.443'</td><td>W93° 01.443'</td><td>W93- UL443</td><td>W93" D1.443 W93" D1.443</td><td>W93° 01.443'</td><td>W93" 01.443'</td><td>W93" 01.443</td><td>W93° D0.475</td>	W93° 00,585'	W93° 00.585'	W93° 00.585	W93° 00.585 W93° 00.585	W93° 00.585'	W93° 00.585	W93" 00.585'	W93° 00.585 W93° 00.429	W93° 01.443'	W93° 01.443'	W93- UL443	W93" D1.443 W93" D1.443	W93° 01.443'	W93" 01.443'	W93" 01.443	W93° D0.475
gnikesW tist2	W93" 00.683"	W93° 00.683'	W93° 00,683'	W93° 00.683°	W93" CO.683 W93" CO.683	W93° 00.683'	W93° 00.683'	W93° 00.683'	W93° (0) 683 W93° (0) 587° W937 (0) 587	W93° 01.351'	W93° 01.351'	W83 UL331	W93* 01.351*	W93° 01.351'	W93° 01.351'	W93° 01.351'	W93* 01.000 W93* 01.000																
End Morthing	782-84. 19784.	N44° 49.284'	N44° 49.284'	N44° 49.284'	N44° 49.284 N44° 49.284 N44° 49.284	N44° 49.284'	N44° 49.284'	N44° 49.284'	N44° 49.284" N44° 49.133° N44° 49.133	N44° 47 144'	N44° 47 144'	N44 47.144	N44° 47,144' N44° 47,144' N44° 47,144'	N44° 47.144'	N44° 47 144'	N44° 47 144'	N44° 46.256 N44° 46.256 N44° 52.507																
Start Northing	N44° 49.797 N44° 49.797	N44° 49.797'	N44° 49.797'	N44° 49.797'	N44° 49.797 N44° 49.797 N44° 49.797	N44° 49.797'	N44° 49.797'	N44° 49.797	N44" 49.770 N44" 49.270	N44° 47.832'	N44° 47.832'	1044 41.032	N44° 47, 832 N44° 47, 832 N44° 47, 832	N44° 47.832'	N44° 47.832'	N44° 47.832°	N44° 45.389 N44° 45.389 N44° 52.871																
Run	, <u>1</u> , 2,	ro.	22	5	מ ט ט	S	c)	ß	ည် ဖ ဖ	4	4 -	ŧ	4 4 4	4	4	4	2 2																
Кеасћ		7	7	7	2	7	7	7	L 7 7	80	œ o	0	ထ တ ထ	80	00	œ	20 22 4																
(лу) әбү	W W	ო	4	2	7 N. 17	-	-	7	N M N	4	7 5	+	7 7 N	7	2	2																	
Sample length (whole body, cm)	35	32.5	38	52	Z 2	6	4	14.5	28.5 28.5	36.5	ह ४	ક	36 36	12	4	13	₹ ≒ 8																
Sample mass (whole body, g)	267.62	208.65	249.48	90.72	90.72	13.61	22.68	36.29	36.29 226.80 131.54	285.76	181.44	70 107	312.98	36.29	27.22	27.22	84.65 337.72 337.12																
Taxa (common)	W bass Sm bass	Sm bass	Sm bass	Sm bass	Sm bass Bluegill Bluegill	Bluegill	Bluegill	Bluegill	Sm bass W bass	W bass	W bass	OIII Dass	Sm bass Sm bass Sm bass	Bluegill	Bluegill	Bluegill	Smbass Findum																
GI 9 ⁸ 7	280FN1	292FN1	293FN1	294FN1	295FN1 296FN1 297FN1	298FN1	299FN1	300FN1	302FN1 302FN1 303FN1	304FN1	305FN1	1000	309FW	310FN1	311FN1	312FN1	316FN1																
∐ sussiT	280FN 280FN 281FN	292FN	293FN	294FN	Z95FN Z96FN Z96FN	298FN	299FN	300FN	307FN 302FN 303FN	304FN	305FN	N 1000	N-108 N-108 N-1006	310FN	311FN	312FN	313FN 315FN 315FN																
GI blei7	8 8	292	293	294	88 88 IS	238	586	300	20. 20. 20. 20.	304	305	8	30, 30, 30, 30, 30, 30, 30, 30, 30, 30,	310	311	312	316 316																

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Taxa abbreviations: Freshwater drum = F drum; Smallmouth bass = Sm bass; White bass = W bass; Green sunfish = G sunfish Table A-1. 3M Analysis of Fish Tissue Samples for PFCs (ND = RL)

¥od∃4	1.58	2.45	0.25	0.82	1.10	0.56	0:30	\$ \$ \$ \$	0.90	0.72	0.57	1.0 0.33 0.55	0.27	0.32	0.47	0.45	0.33	69'0	0.33
AnU79	2.10	2.65	0.28	28.0 E 88.0	0.98	0.62	0.33	S	0.85	0.63	0.58	0.37	0.29	0.33	0.54	1470	0,34	0.70	0.38
A039	2.99	2.97	0.52	# 8 %	1.33	0.87	0.50	27.7 88.0 88.0	1.20	1.10	1.33	12 04 80	0.46	0.35	0.80	-4 <u>77</u>	0.88	0.74	0.56
₽₽₽₽	< 0,05	0.28	90.0	0031 0000	0.37	< 0.1	< 0.1	\$ 10 V	0.16	0.42	0.29	700 P	< 0.1	¢0.1	< 0.1	k0.1	70.0	< 0.05	90:0
₩ PEOA	<01	< 0.1	< 0.1	0.05	< 0.05	< 0.05	< 0.05	\$0.05	< 0.05	90'0	< 0.05	6.06 6.06 < 0.05	< 0.05	< 0.05	< 0.05	<.005	<0.1	< 0.1	< 0.1
AqHAq	< 0.05	0.05	< 0.05	\$000 \$000 \$000 \$000	<0.1	< 0.1	< 0.1	0 0 0	< 0.1	< 0.1	<01	¢0.1	< 0.1	< 0.1	< 0.1	ya.	×0.05	< 0.05	< 0.05
AxH44	0.11	90:0	0.12	<0.05 0.13 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <	< 0.1	< 0.1	<0.1	0 0 TO	0.27	< 0.1	< 0.1	\$ 00 m	0.15	< 0.1	< 0.1	<0.1	<0.1	< 0.1	c 0 ×
A∍qqq	<0.1	<0.1	0.20		< 0.1	<0.1	< 0.1	10 5	<0.1	< 0.1	< 0.1	5 5 5	< 0.1	0.10	< 0.1	- - - - - - - - - - - - -	< 0.25	< 0.25	< 0.25
₩	< 0.5	< 0.5	1.37	20° 50° 50° 50° 50° 50° 50° 50° 50° 50° 5	< 0.25	< 0.25	< 0.25	X X V	< 0.25	< 0.25	2.90	, 0.28 , 0.28 , 0.28	< 0.25	< 0.25	< 0.25	<0.25	< 0.25	< 0.25	< 0.25
ASO74	0.59	0.29	0.13	0.75 0.08 0.03	0.18	80.0	90.0	0.00 0.00 0.00	0.13	90.08	0.10	0.09 0.05 0.07	9.05	0.05	0.07	0.03	\$970	0.05	0.05
PFOS	47.0	19.8	9.6	98.9 91.2 7.38	14.6	224.0	62.4	\$ 12 kg	25.2	29.1	32.1	20 20 30	14.1	10.7	11.2	14.0	18.2	27.6	11.7
b ⊦H2	< 0.05	< 0.05	< 0.05	60.05 <0.05 <0.05	< 0.05	0.37	0.30	0.00 0.00 0.28	< 0.05	< 0.05	< 0.05	0.30 c.005	< 0.05	< 0.05	< 0.05	< 0.05	<0.005	< 0.05	< 0.05
\$844	< 0.05	< 0.05	< 0.05	\$000 y	< 0.1	9.14	< 0.1	\$ \$ \$	< 0.1	< 0.1	<0.1	\$ \$.	<0.1	<01	<0.1	<0,1	×0.05	< 0.05	< 0.05
Епа Westing	W93° 00.983°	W93° 00.983°	W93° 00.490'	W93* 02.490* W93* 00.490* W93* 00.490*	W93° 00.659'	W93" 00.530"	W93° 00.530'	W93* 00.530 W93* 00.530 W93* 00.530	W93° 00.530'	W93° 00.756	W93° 00.756	W93" 00.756 W93" 00.756 W93" 00.490	W93° 00,490'	W93° 00.490'	W93° 01.482'	W93° (01.482	W93° 01.48Z	W93" 01.482"	W93" 01.482"
gnitseW វាស់2	W93° 00.992'	W93* 00.992'	W93° 00.437°	W93* 00.437	W93 00.623	W93* 00.659'	W93° 00.659'	W37" 00.659 W93" 00.659	W93* 00.659	W93° 00.689'	W93° 00,689'	W83* 00.689 W93* 00.689 W93* 00.634	W93° 00.634'	W93° 00.634'	W93° 01.507'	W93* 0 1507	W93" 01:507"	W93° 01.507'	W93° 01 507'
End Morthing	N44* 52.507*	N44° 52.507'	N44° 51.038'	N44*51.038 N44*51.038	N44° 50.990'	N44° 50.572'	N44° 50.572'	N44° 50,572 N44° 50,572 N44° 50,577	N44° 50.572'	N44° 50.435'	N44° 50.435'	N44° 50.435 N44° 50.435 N44° 49.118	N44° 49.118'	N44° 49.118'	N44° 47.811°	N44* 47.811	N42: 47.811"	N44° 47.811'	N44° 47.811'
gnidhoM that2	N44° 52.871'	N44° 52.871'	N44° 51.463'	M44*51463 M44*51463	N44° 51 137'	N44° 50.990'	N44° 50.990'	N44*50.990 N44*50.990	N44° 50.990'	N44° 50.689'	N44° 50.689'	N44* 50.888 N44* 50.689 N44* 49.400	N44° 49.400	N44° 49.400'	N44° 47 945'	N44* 47.945	N44* 47.945	N44° 47 945'	N44° 47 945
uny	1	7	თ	o	\$	£	Ξ	+ + +	£	12	12	2 2 2	7	7	9	9	9	g	9
Кеасћ	۵	9	9	6 6 6	9	9	9	9 9	9	9	9	0 0 L	7	7	œ	8	8	80	∞
(1y) əgA	e	17	92	6 7 8	80	2	80		က	60	4	91 8 A	2	7	7	2	. 2	ю	4
Sample length (whole body, cm)	83	88	32.5	24.5 17	88	12.5	11.5	22 1 2 2 4 2 4 4 4 4 4 4 4 4 4 4 4 4 4 4	34.5	58	30.5	¥ 9 0	14	13.5	13.5	12	7)	17	19
Sample mass (Whole body, g)	254.01	594.21	176.90	186.58 1814 15.38	258.55	18.14	13.61	3175 (44.33	213.19	131.54	172.37	226.80 (5.35) (2.68	27.22	22.68	27.22	22.68	18.14	63.50	77.11
(nommos) sxs ⁷	Sm bass	F drum	F drum	F. Futum Buegill	F drum	Bluegill	Bluegill	Bluegiff Briegiff	F drum	F drum	F drum	F drum Bluegill Bluegill	Bluegill	Bluegill	Bluegill	Buegil	Bluegill	Bluegill	Bluegill
GI daJ	317FN1	318FN1	319FN1	320FN1 321FN1 32ZFN1	323FN1	325FN1	326FN1	329FM 329FM	331FN1	332FN1	333FN1	326-hr 325-hr 336-hr	337FN1	338FN1	340FN1	34/FN	343FM	344FN1	345FN1
Ol eussi∏	317FN	318FN	319FN	320FN 322FN	323FN	325FN	326FN	328FN W7825	331FN	332FN	333FN	334FN 336FN 336FN	337FN	338FN	340FN	341EN	343FN	344FN	345FN
Gi bləj∃	317	318	319	8 Z 3	323	325	326		331	335	333	3 8 8	337	338	340	341	373	344	345

Table A-1. 3M Analysis of Fish Tissue Samples for PFCs (ND = RL)

	Aodaq	0.87	8 8 90 8 80	0.67	0.43	0.47	7 3	0.79	1.29	1.27	0.70	1.11	0.26	0.49	<u> </u>	1.51	1.75	2.07	880
	AnU3q	1.01	1.02	0.81	0.64	0.53	9,95 1,28	0.91	1.31	1.18	10 00 00 00 00 00 00 00 00 00 00 00 00 0	1.44	0.41	0.53	5 Z 5	1.65	2.01	2.48	0.57
	AG79	2.06	228 208 100 100	1.09	1.05	0.65	9 3 3	1.09	1.89	1.97	8 8 8	3.40	0.53	0.49		3.62	4.11	5.12	85
	PFNA	0.40	84.0 0.05	< 0.05	90.0	< 0.05	0.42 0.20 < 0.05	< 0.05	90.0	< 0.05	<0.005	1.11	<0.05	<0.05	2 00 E	0.51	0.59	0.72	84 1
	A079	<0.1	5 6 5	<0.1	<0.1	<01	70, 0 70°	< 0.1	<0.1	<01	- 10 FG	< 0.25	< 0.25	< 0.1	0 v v	< 0.25	< 0.25	< 0.25	<0.25
	AqH49	< 0.05	<0.05 <0.05 <0.05	< 0.05	< 0.05	< 0.05	<0.05 <0.05 <0.05	< 0.05	< 0.05	< 0.05	<0.05 <0.05 <0.05	< 0.1	<0.1	< 0.05	<0.05 <0.05 <0.05	< 0.1	× 0.1	<0.1	. 1 0
sunfish	AxH7q	< 0.1	- 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5	< 0.1	< 0.1	< 0.1	를 등 를	0.11	<01	0.16	\$ +5 5	< 0.25	< 0.25	< 0.25	<0.25 <0.25 <0.25	< 0.25	< 0.25	< 0.25	62X
9	А₃Ч¬Ч	< 0.25	200 200 200 200 200 200 200 200 200 200	< 0.25	< 0.25	< 0.25	\$0.25 \$0.25 \$0.25	< 0.25	< 0.25	< 0.25	*0.25	< 0.25	< 0.25	<0.1	0 2 0	< 0.25	< 0.25	< 0.25	- 0.25 0.25
Green sunfish	ABiq	< 0.25	<0.25 <0.25 <0.25 <0.25	< 0.25	< 0.25	< 0.25	0.025 0.025 0.025	< 0.25	< 0.25	< 0.25	<0.25 <0.25 <0.25	< 0.25	< 0.25	< 0.35	0.35	2.41	< 0.35	< 0.35	<038
reen (A201q	0.52	0.46	0.18	0.04	0.04	8 8 8	0.22	0.40	0.41	200 40	77.0	0.05	9.05	0.80 7.33 0.80	0.89	0.86	0.88	0.06
= W bass; G	PFOS	34.8	8 33 E	16.5	29.4	8.7	46.8 36.9	20.1	32.6	32.0	178	59.2	8.5	12.4	8 8 8	48.8	70.2	7.5.7	17.5
3S = W	PFHS	< 0.05	0.05 < 0.05 < 0.05	< 0.05	< 0.05	< 0.05	\$009 \$000	< 0.05	< 0.05	< 0.05	<0.005 80.05 80.05	0.07	< 0.05	0.23	0.28 7.02 7.70	90'0	0.05	90.0	011
nite ba	8834	< 0.05	2002 2008 2008	< 0.05	< 0.05	< 0.05	<0.05<0.05<0.05	< 0.05	< 0.05	< 0.05	<0.005	< 0.25	< 0.25	< 0.25	\$20.5 \$20.5 \$20.5	< 0.25	< 0.25	< 0.25	<0.25
Sm bass: White bass	Eud Westing	W93* 06.169'	W93° 06.169 W93° 06.169 W93° 06.169	W93* 06.169'	W93° 06.169°	W93° 06.169°	W93" (5.689) W93" (5.689)	W93° 05.689'	W93" 05.689'	W93" 05.689'	W93° US 689° W93° US 689° W93° US 689°	W93* 07.495	W93° 07.495'	W93° 07.495'	W93" 07.857 W93" 07.857	W93° 07,857	W93° 07.857	W93° 07.857'	W93* 07'857
II		W93° 06.842'	W93° 06.842 W93° 06.842	W93* 06.842'	W93° 06.842'	W93° 06.842'	W93" 06.374" W93" 06.374" W93" 06.374	W93* 06.374'	W93° 06.374'	W93° 06.374'	WS3* 06.374 W93* 06.374 W93* 06.374	W93° 07.830'	W93° 07.830°	W93° 07.830°	W93° 08.846° W93° 08.846°	W93* 08.846	W93° 08.846°	W93° 08.846'	W93* 02.846
malimonth bass		N44° 56.031°	XXIII A TO THE RESERVE OF THE RESERV	N44° 56.031'	N44° 56.031'	N44° 56.031'	N44" 56.528" N44" 56.528" N44" 66.528	N44° 56.528°	N44° 56,528'	N44° 56.528'	N44° 56.528 N44° 56.528	₩ 3	3	N44° 55.335	N44" 54.948" N44" 54.948	N44° 54.948'	N44° 54.948'	N44° 54.948'	N44* 54.948*
ND = RL) Fdrim: Sma	.	N44° 55 451'	N44° 55.451 N44° 55.451 N44° 55.451	N44° 55 451'	N44" 55.451'	N44° 55.451'	N44* 55.8551 N44* 55.8561 N44* 55.865	N44° 55.955'	N44" 55.955	NAA" 55 955'	N44*55.965	N44° 55 109'	N44° 55.109	N44° 55.109°	N44* 53.870 N44* 63.870 N44* 53.870	N44° 53.870'	N44° 53.870'	N44° 53.870'	N 44 *53870
- CS (-		,		7	. ~	7	6 8 0	80	œ	œ		, α	. «	œ	6 6 O	6	6	6	. o r
tor P	Reach	7	, (n) (n) (n)		, ო	ო		HHIS	6			, (, 2	2	2 2 2	2	8	2	2
Samples tor PFCS Erochwater drum	(7V) 9@A	u			, r ₂	9	16 E E	2	6	, ,	n (a) (a)	,	4	70		4	ß	VO.	8
sue Sa		5	8 8 8 8	300		45	8 2 2	8	i &	; ;	35 45 45 45 45 45 45 45 45 45 45 45 45 45	2 8	38.5	17.5	5	88	36.5	67	
ish Tis	Sample mass (whole body, g)	0.00	50.072		40.82	34.75	772.16 190.51	87 87	208.65		199.58	8	63.50	54.43	335.66 172.37	45.36	281.23	381.02	788
Table A-1. 3M Analysis of Fish Tissue Samples for PFCS (ND = RL)	Taxa (common) sxsT		W Dass	8000 C	Sm bass		F drum	Sm hase	San Es		Sm bass	⊪Bensa :	W Dass	Blued	W bass	W bass	W bass	W has	
3M Anal)	 al 4₽7		346FN1 346FN1 350FN1	8	352FN1	SEATON 1	365FN1	260FN1	September 1	1N1000	361FN1 36ZEWI 363FNI	364-N	366FN1	367EN1					
e A-1.∶	Gl ənzsīī		346FN 349FN 350FN	3 	352FN	N JOSE		September 1	N INCOME	Souri	362FN 362FN	364FN	365FN 366FN	367FM	N=888 N=888 N=078	372FN	373FN	27476	i viet
Tabl	Fleld ID		8 8 8	Ş.	352	3 2	3 8) 8	g 8	96	383 383	Ř	365	367		372	373	3 8	37.

Table A-1. 3M Analysis of Fish Tissue Samples for PFCs (ND = RL)

	PFD0A	090 470	1.36	0.83	0.73	01-1 88 BI	0.36	0.64	99'0	1 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	1.33	1.00	2.52	0.00 0.00	1.44	1.37	#	1, 108 1, 108 1, 108
	A⊓U∃q	0,95	1.39	0.79	0.70	27.7. 27. 00.98	0.54	0.72	0.72	4,00 1,13 1,00 1,00 1,00 1,00 1,00 1,00 1	1.72	1.31	2.79	98.0	1.70	1.65		
	₩ 034	3 2	2.83	1.04	0.72	89. 77 580	0.72	1:17	99.0	200 200 77.1	2.63	2.37	5.13	26.0	3.93	4.14		
	₽N∃d	0.57 0.05	0.50	< 0.05	< 0.05	4005 4005	< 0.05	< 0.05	<0.1	<0.1 <0.1 0.10	0.11	0.15	0.32	0.12 0.07	0.53	0.57	1	0.38
	AO∃q	\$. \$ \$	< 0.25	< 0.25	< 0.25	\$ 50 00 \$ 50 00 \$ 50 00	< 0.25	< 0.25	< 0.25	\$0.25 50.25 50.25	< 0.25	< 0.25	< 0.25	\$0.5 \$2.6 \$2.6 \$2.6	< 0.25	< 0.25	€ 0.28	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$
	AqH7q	1.00	< 0.1	× 0.1	< 0.1	5 5 5	< 0.1	<0.1	< 0.05	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	< 0.05	< 0.05	< 0.05	60.0560.0560.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.0570.05<td>< 0.05</td><td>< 0.05</td><td>\$</td><td>8 8 8 1</td>	< 0.05	< 0.05	\$	8 8 8 1
sunfish	AxH3q	<0.25	< 0.25	< 0.25	< 0.25	<0.25 <0.25 <0.25	< 0.25	< 0.25	< 0.25	\$0.25 \$0.25 \$0.25	< 0.25	< 0.25	< 0.25	0.0250.0350.036	< 0.35	< 0.35	\$6 60 80	70
G	A∍q∃q	.0.2s	< 0.25	0.39	0.72	049 0.25	< 0.25	< 0.25	0.17	0.00 0.00 0.00	< 0.05	< 0.05	< 0.05	coos 0.19 <0.1	<0.1	< 0.1	10	5.5.5
sunfish =	₽ 84	\$ 8 8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	< 0.35	< 0.35	< 0.35	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	< 0.35	< 0.35	< 0.1	5 5	< 0.1	< 0.1	< 0.1	312	< 0.25	< 0.25	\$20 v	<0.26 <0.26 <0.25
Green su	A ≳0∃q	7. 21	0.65 <	0.14 <	0.27 <	20 00 × × × × × × × × × × × × × × × × ×	0.20 <	0.12 <	> 20.0	2900	> 20.0	> 80.0	0.23	0.20	> 67.0	> 81.1	. #77	8 2 8
s; Gre	PFOS		47.7 0.	28.7 0.	21.2 0.		11.0 0.	26.8 0.	19.1 0.	20 00 00 00 00 00 00 00 00 00 00 00 00 0	76.5 0.	60.9	117.0 0.	77.8 0 30.2 0 6.7 0	59.1 0.	59.7 1.	2 736	
= W bass;	3038																	
	SH±d	90.0	0.05	< 0.05	< 0.05	0.00	< 0.05	< 0.05	< 0.1	, co.	<0.1	< 0.1	< 0.1	<0.01 <0.05 <0.05	< 0.05	0.08	500	<0.05 <0.05 <0.05 <0.05
/hite b	SB±d	40.28 40.28	< 0.25	< 0.25	< 0.25	4025 4025 4025	< 0.25	< 0.25	<0.1	å	×01	< 0.1	<0.1	2	< 0.05	< 0.05	600	8 8 8
Sm bass; White bass	End Westing	W93° 07.857	W93° 01.486'	W93" 00.022'	W93° 00.022'	W93" 00.022' W93" 00.022 W92" 56.373	W92° 56,373°	W92° 56,373'	W92° 56.333'	W92° 56.333 W92° 56.333 W92° 56.091	W92° 56.091'	W92° 56.091'	W92° 52.645'	W92° 53.405 W93° 01.343 W93° 01.343	W93° 01 343'	W93° 01,343'	M95 01.345	W98" 01.345" W98" 01.345"
п	Start Westing	WSC* 08.846	W93° 01.546'	W93° 00.491'	W93* 00.491	W93* 00.491* W92* 56.800	W92° 56.800'	W92° 56.800'	W92° 56.390'	W92" 56.390' W92" 56.390' W92" 56.091'	W92" 56.091'	W92° 56,091'	W92° 52.645'	W92" 53.470" W93" 02.431" W90" 02.431	W93° 02.431'	W93° 02.431'	W33 02.431	W92° 02.431 W92° 02.431
Smallmouth bass	gnirthoM bn3	N44* 54.948 N44* 47.305	N44° 47.305'	N44" 46.286'	N44° 46.286'	N44* 46.286 N44* 46.286 N44* 45.230	N44° 46.230'	N44° 46.230'	N44° 45.970°	N44" 45.970 N44" 45.970 N44" 46.885	N44° 46.885	N44° 46.885'	N44° 46.162'	N44" 45.896" N44" 53.535 N44" 53.535	N44° 53.535'	N44° 53.535	144 51 515	N44" 53.535 N44" 53.535 N44" 53.535
drum;	gnidhoM trat2	W4* 53.870	N44° 47.665°	N44° 46.243'	N44° 46.243'	N44* 46.243 N44* 46.051*	N44° 46.051'	N44° 46.051'	N44° 45.925'	N44* 45.925 N44* 45.925 N44* 46.885	N44° 46.885°	N44" 46.885'	N44° 46.162'	N44° 45.922 N44° 54.134 N44° 54.138	N44° 54.134'	N44° 54.134'	100° 50 139	M4* 52.134 74* 52.134 74* 52.134
m = F	Run	0 1	7	8	8	8 8 E	13	13	14	2 4 δ	15 N	15	<u>ح</u> ھ	o	9	9	<i>ω</i>	<u> </u>
er drum	Иеасh		ω	80	æ		6	თ	6	6 6 6	o	ი	9	e w 6	3	c)	ĸ	n n n
Freshwater	(1y) əgA	8 7	7	2	2	9 0 0	2	2	က	N 9 9	2	7	2	9 9 U	4	ဖ	m	2 2 2
ons: F	Sample length (whole body, cm)	37.5	23	24.5	26.5	38 SS	23.5	54	19.5	785 77	16	15.5	14.5	18 18	Ж	Я	Ħ	E % 2
reviati	Sample mass (whole body, g)	222.56 86.18	140.61	90.72	108.86	185.97 312.98 86.18	72.57	81.65	99 79	38.28 154.22 63.50	45.36	40.82	31 75	8 8 8 7.27	308.44	290.30	208.65	24 88 84 54 88 85 54 88 85
Taxa abbreviations:	(nommos) sxsT	F-drum.	W bass	Sm bass	Smbass	Sm bass W bass Sm bass	Sm bass	Sm bass	Bluegill	Bluegiii Sm bass	Bluegill	Bluegill	Bluegill	Bluegill Bluegill	W bass	W bass	W bass	W bass W bass
	GI dsJ	3785N1 3795N1	380FN1	381FN1	382FN1	3885FV	386FN1	387FN1	388FN1	380FN1	392FN1	393FN1	394FN1	395FN1 396FN1 397FN1	398FN1	399FN1	EN EN	401FN1 402FN1 403FN1
	Gi ənssiT	378FN 379FN	380FN	381FN	382FN	384FN 384FN 385FN	386FN	387FN	388FN	389FN 390FN 391EN	392FN	393FN	394FN	395FN 396FN 397FN	398FN	399FN	M-000	401EN 402EN 403EN
	단에 ID	373	380	381	382	8 8	386	387	388	380 380	392	393	394	52 88 58 88 58	398	336	8	. 50 401

12

Table A-1. 3M Analysis of Fish Tissue Samples for PFCs (ND = RL)

Taxa abbreviations: Freshwater drum = F drum; Smallmouth bass = Sm bass; White bass = W bass; Green sunfish = G sunfish

				Driver Co. To Company, June 1				100° × 77				1. 5						
Ao@49	1.78	2.48	2.15	\$ 2 8	1.67	0.26	0.61	2 2 3	0.29	0.63	0.28	8 5 E	2.09	0.50	1.51		66.0	1.26
AnU3q	2.16	3.02	1.72	\$ 1 8	1.94	0.27	98.0		0.45	0.68	0.35	2-3-8	1.97	0.57	1.42	3 8 6	1.22	3.52
AG44	3.64	5.85	2.48		3.54	0.47	0.72	7.0 18.8 18.17	1.08	0.77	0.57	372 372	2.28	0.70	1.62	23.2	1.61	2.24
₽FNA	0.58	0.99	0.31	0.29 0.15	0.50	0.18	0.09	**************************************	0.28	90.0	90.0	90.00 0.58	0.20	0.23	0.13	8 5 5	< 0.05	< 0.05
₽FOA	0.40	< 0.25	< 0.25	\$0.25 <0.25	< 0.25	< 0.25	< 0.1	8 8	< 0.1	0.11	< 0.1	20 C01	< 0.1	< 0.1	< 0.1	ē 5. ē	< 0.1	<0.1
AqH3q	0.07	< 0.05	< 0.05	*005 *005	< 0.05	< 0.05	< 0.05	< 0.05 < 0.05 < 0.05	< 0.05	< 0.05	< 0.05	<0.005 <0.005 <0.005	< 0.05	< 0.05	< 0.05	20° - 8° - 8° - 8° - 8° - 8° - 8° - 8° -	< 0.05	< 0.05
₽ĸH⊀Ą	< 0.35	< 0.35	< 0.35	×0.35 ×0.38 ×0.38	< 0.35	< 0.35	< 0.25	60.28 00.28	< 0.25	< 0.25	< 0.25	<0.25 <0.25 <0.25	< 0.25	< 0.25	< 0.25	\$0.28 \$0.28 \$0.28	< 0.25	< 0.25
¥әd∃d	× 0.1	< 0.1	< 0.1		< 0.1	< 0.1	< 0.25	<0.25 <0.25 <0.25 <0.25	< 0.25	< 0.25	< 0.25	00 00 00 02 85 85	< 0.25	< 0.25	< 0.25	,025 (025 (025	0.28	< 0.25
PFBA	< 0.25	< 0.25	< 0.25	40.2540.2540.26	< 0.25	< 0.25	< 0.25	40.2540.2540.25	< 0.25	< 0.25	0.29	<0.25 <0.25 <0.25	< 0.25	< 0.25	< 0.25	*0.8 *0.8 *0.8	< 0.25	< 0.25
A≳O∃9	0.74	0.63	0.24	0.22	0.61	90.0	20.0	80 83 60	0.10	0.11	80.0	0.77	0.35	0.16	0.35	0.22	0.72	0.46
PFOS	59.7	105.0	20.9	4 2 5 2 2 5 2 2 5	62.2	5.9	22.1	12.0 104.0 34.5	14.6	21.5	10.7	4.5	9.1	21.0	19.2	\$ 2 E	31.9	41.9
PFHS	0.34	90'0	< 0.05		< 0.05	< 0.05	< 0.05	8 8 8 8 8 8	< 0.05	< 0.05	< 0.05	*008 *008 *008	< 0.05	< 0.05	< 0.05	4005 8005 8005	< 0.05	< 0.05
PFBS	< 0.05	< 0.05	< 0.05	\$0.05 \$0.05 \$0.05	< 0.05	< 0.05	<0.1	100.	< 0.1	< 0.1	<01	£ 10 0	<0.1	< 0.1	< 0.1	9.8	< 0.1	× 0.1
End Westing	W93° 00.813'	W93" 00.813"	W93° 00.431'	W93* 00.733 ■ W93* 00.733 ■	W93" 12.042'	W93° 07.331'	W93° 07.331'	W93° 07,424 W92° 57.782 W92° 57.782	W92° 56.380'	W92° 53.427'	W92° 53.427	W92° 53.427 W92° 53.427 W92° 57.914°	W93° 00.543'	W93* 00.543'	W93* 00.543*	W93° 00.543° W93° 04.281° W93° 04.281°	W93° 04.281'	W93° 04.281'
Start Westing	W93° 00.813°	W93" 00,813'	W93° 00.537	W83° 00.240 W83° 00.240 W93° 00.240	W93° 11.978	W93° 08.835	W93° 08.835	W93° 07.869 W92° 58.174 W92° 58.174	W92* 56.380	W92° 53,478'	W92* 53.478'	W92" 53478 W92" 53478 W92" 58.071	W93° 00.219°	W93° 00.219°	W93° 00,219'	W93° 00.219 W93° 04.565 W93° 04.565	W93" 04.565	W93° 04.565
Bud Morthing	N44° 52.007'	N44° 52.007'	N44° 49.158'	N44" 48.2555 N44" 48.2557 N46" 48.255	N44° 54.640'	N44° 55.312'	N44° 55.312'	N44" 55.34% N44" 62.05	N44* 45.898'	N44° 45.898°	N44° 45.898'	Nut. 45 898 Nut. 45 898 Nut. 45 257	N44° 48.449'	N44° 48.449'	N44° 48.449'	Wer 58.800	N44" 56.890"	N44" 56.890'
gnirtho M hsJ2	N44° 52.007'	N44° 52.007'	N44° 49.280'	N44" 48 936. N44" 48 936. N44" 48 936	N44° 54.708'	N44° 53.874'	N44° 53.874'	N44" 55.088 N44" 46.340	N44° 45.898°	N44° 45.926'	N44° 45.926'	N44° 45.926 N44° 45.926 N44° 45.285	N44° 48.956'	N44° 48,956'	N44° 48.956'	N4" 48.958 N41 58.889 N44" 58.889	N44° 56.889°	N44° 56.889'
uny	5	5	œ	9 9 9	တ	9	6	* * *	17	9	9	2 2 X	9	10	9	유 영	9	9
Кеасһ	ဖွ	9	7		-	7	7	N a a	თ	5	9	<u>2</u> 2 0	7	7	7	~: 7. 3.	4	4
(1y) egA	7	2	7	3 8 Z	9	ო	10	, 4 • •	-	က	7	2 + 2	74	9	15	.n. 8 e	2	4
Sample length (whole body, cm)	40	35.5	38.5	38	37	28	36	E 2	13	18	13.5		46	49	36.5	67 Sar	R	Я
Sample mass (whole body, g)	435.45	276.69	344.73	(40.81 348.27 36.28	340.19	122.47	258.55	28.55 28.55 55.25	13.61	68.04	31 75	2.68 13.61 308.44	489.88	730.28	349.27	317.51 743.88 276.69	163.29	331,12
Taxa (common)	W bass	W bass	F drum	F.drum.	W bass	F drum	F drum	Bluegill W bass Sh bass	Bluegill	Bluegill	Bluegill	Bluegill W bass	F drum	F drum	F drum	Fatum Fatum Fatum	Sm bass	Sm bass
Cl de l	404FN1	405FN1	407FN1	408FN1 408FN1 410FN1	411FN1	412FN1	413FN1	415FNI 415FNI 416FNI	417FN1	419FN1	420FN1	421FN1 425FN1	426FN1	427FN1	428FN1	WHICH ACHEMI	432FN1	433FN1
(Il eussi)	404FN	405FN	407FN	N-808-W	411FN	412FN	413FN	4/4FN 4/5FN 4/6FN	417FN	419FN	420FN	423FN 423FN	426FN	427FN	428FN	Agen Agen Agen Agen Agen Agen Agen Agen	432FN	433FN
Ci elei ID	404	405	407	8 8 9	411	412	413	4 415	417	419	420	5 6 5	456	427	428	8.8.5	432	433

2.10 0.63

69.0

276.69

F drum Forum

448FN1 447FN1

448FN

449 448

149.69

446 44 412.77

452FN

0.40

0.33

69.0 0.48 1.11

0.61

Sample mass (whole body, 9)

Taxa (common)

Ci daJ

Lield ID

181.44

Sm bass

434FN1

8 \$

394.63

442FN

442

690

1.10

2

3.31

6.43 209

1.13 2.64

1.12 0.75

4.

1.8

PFDoA

AnU₄9

PF0A

12

Nover.

Taxa abbreviations: Freshwater drum = F drum; Smallmouth bass = Sm bass; White bass = W bass; Green sunfish = G sunfish Table A-2. AXYS Analysis of Fish Tissue Samples for PFCs (ND = RL)

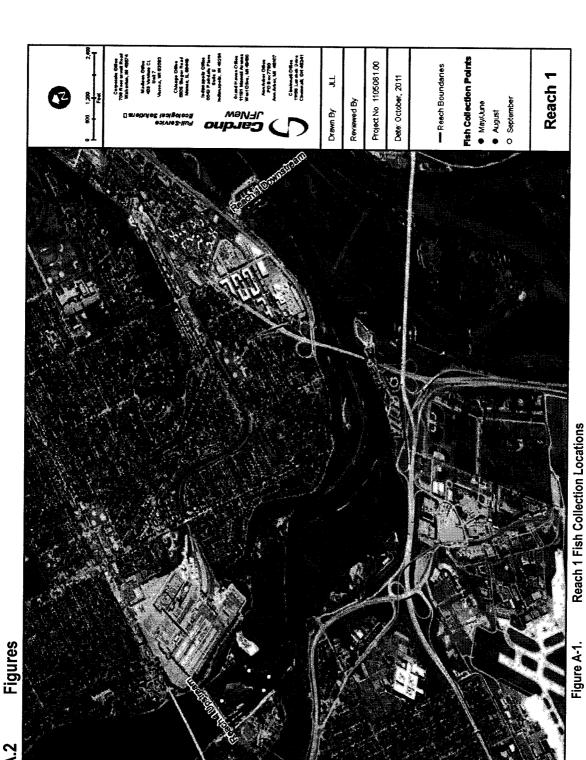
Aodaq	\$ 8 \$ \$	< 2.5	< 2.5	< 2.5	8 8 8	<2.5	< 2.5	< 2.5	\$25 \$ 12 \$24	<2.5	< 2.2	< 2.4	8 8 8	< 2.4	<2.3	<23	<223 K23
ArrU74	\$25 \$25	<2.5	< 2.5	<2.5	\$ \$ \$ \$	<2.5	<2.5	<25	\$2.5 \$2.5 \$2.4	<2.5	<2.2	< 2.4	8 8	< 2.4	<2.3	<23	2 2
₽£DA	2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	<2.5	< 2.5	<2.5	<2.5 <2.5 <2.5	< 2.5	<2.5	< 2.5	3.78 < 2.5 *2.4	<2.5	<2.2	2.62	\$ 52 \$	<2.4	<2.3	< 2.3	33.5
₽FNA	¢25 \$2.	< 2.5	<2.5	< 2.5	\$2. \$2. \$2. \$2.5 \$2.5	< 2.5	< 2.5	<2.5	<25 <25 <25 <25 <24 <24 <24 <25 <25 <25 <25 <25 <25 <25 <25 <25 <25	< 2.5	<2.2	< 2.4	225 23	<2.4	<23	<2.3	22 × 28 × 28 × 28 × 28 × 28 × 28 × 28 ×
₽F0A	\$25 \$25 \$25	<2.5	< 2.5	<2.5	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	<25	< 2.5	<2.5	2 2 2 2	<2.5	<2.2	< 2.4	2 2 2 2 2	<2.4	<2.3	<2.3	g . g
AqHaq	2 - 2 - 2	<2.5	< 2.5	< 2.5	8 8 5	< 2.5	< 2.5	<2.5	8 8 8	< 2.5	<22	< 2.4	g. v. z	< 2.4	<2.3	<23	3 8
AxH79	2 2 2	<2.5	< 2.5	< 2.5	25 25 22-52-52-52-52-52-52-52-52-52-52-52-52-5	< 2.5	< 2.5	< 2.5	8 2 2	< 2.5	<22	< 2.4	2 2 2	<2.4	<23	<2.3	\$ \$
A∍q∃q	£ £ £	<2.5	< 2.5	< 2.5	2 2 2	< 2.5	< 2.5	< 2.5	25 25	<2.5	<2.2	<24	3 8 3	<2.4	< 2.3	<23	8 8
₽ 849	23 23 25 28 28 25	<2.5	<2.5	< 2.5	g 5, 5,	<2.5	<2.5	<2.5	3 3 3	<2.5	<22	<24	3 9 3	<2.4	<2.3	<23	8 8
A ≳O∃9	2 2 3	4.83	< 2.5	<2.5	8 8 8	< 2.5	< 2.5	<2.5	8 - 5 . 8	<2.5	<2.2	< 2.4	8 8 8	<2.4	<23	<2.3	£23 \$23
\$0±d	2 8 4	75.3	34.3	94	2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2	59.5	37.4	12.6	98.6 417.2 29.3	13.2	46.3	61.9	8 8 8	27.6	9.33	44.4	2 3
bEH2	\$50 \$50 \$50	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	\$50 \$50 \$30 \$30 \$30	< 4.9	< 4.4	< 4.9	< 4.5 4.5	< 4.8	< 4.6	< 4.7	7, 2, 2, 2, 2, 2, 2, 3, 4, 2, 3, 4, 2, 3, 4, 3, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
bEB2	05 - 05 - 05 - 05 - 05 - 05 - 05 - 05 -	< 5.0	< 5.0	< 5.0	8 89	< 5.0	< 5.0	< 5.0	- 65 - 2 5 - 2	< 4.9	< 4.4	V 4.9	2 8 2	< 4.8	< 4.6	<4.7	\$ \$
End Westing	125-52-58W	W93° 00.999°	W93° 05.240'	W93" 09.064"	W33" 11.459" W93" (1.443"	W93° 00.475'	W92° 56.370'	W92° 56.022'	V92° 55,336 N92° 52,438 N93° 00.780°	W93° 01 129'	W93° 00.922'	W83" 01 769	W93* 00.B47 W93* 04.305 W93* 04.305	W93° 03.620'	W93° 02.999°	W93" 10.826'	M93° 07.886'
	. W92°	W93	W93*	.K6M	Wess.	.K63	W92°	W92	W92*	.E6M	W93	Was	W93*	.K6M	W93°	W93	W93
Start Westing	W92*54778 W92*54778 W93*01399	W93° 01.438'	W93° 06.019'	W93° 09.874'	W93* 12.049************************************	W93° 00.664'	W92° 57.877"	W92° 56.028'	W92° 55.897 W92° 52.724 W93° 00.780	W93° 01 757'	W93" 01.069"	W93" U2.478	W93" 04.519 W93" 04.519 W83" 04.519	W93° 04.049'	W93° 02.890′	W93° 11.382'	W93* 08.260
End Morthing	N44" 45 382" N44" 45 392 N44" 47.471	N44° 46.447	N44° 56.589°	N44° 53.865'	N44" 54,149 N44" 54,001 N44" 53,636	N44° 49.047'	N44° 46.244	N44° 46.982'	N44° 47.108 N44° 46.230 N44° 52.020	N44° 53.279°	\$ 3	N44 53./32	N44" 55.885 N44" 56.885 N44" 56.885	N44° 56.553°	N44° 55.458'	N44° 53.634'	N44" 54 879 N44" 49 284
BridhoM hate	46.426	7 171'	6.139'	3.664"	54,611° 54,606° 53,972°	9.719	6.162'	6.725	47.038° 46.526 51.331°	3.736'	53.430	94.153	5/7977 5/7977	5.848'	5.805'	3.743'	54.265 49.797
paidboll tat2	N44" 46.426 N44" 46.426 N44" 47.743	N44° 47 171	N44° 56.139'	N44° 53.664	N44° 54.511' N44° 54.606' N44° 53.972	N44° 49.719'	N44° 46.162	N44° 46.725	N44* 46.526 N44* 51.331"	N44° 53.736'	N44°5	0 444	N44" 56.797 N44" 56.797	N44° 56.848′	N44° 55.805'	N44° 53.743'	N44 54.265
uny	8 10 4	ო	7	2		4	7	4		-	7	4		7	2	7	မ မ
Кеасћ	<u>δ</u> 5 ω	œ	3	2		7	6	ത	6 2 6	2	ro r	n		4	4	-	S . K
(ty) agA		2	ო	2	0 4 4	7	4	£	э <mark>к</mark> к	ო	ر د	4	Ψ 4 . b	ю	ဖ	œ	NZO
Fish length (cm)	30	25.5	27	26.5	8 8 8	42.5	20	4	3 2 8	31.5	88 8	ę	8 8 8	31.5	85	38.5	8 8
Fish mass (9)	326.59 108.86 226.80	185.97	249.48	21772	716.68 507.81	1016.05	158.76	725.75	458.13 449.06	426.38	449.06	60.07	828.15 317.51 382.67	222.26	1143.05	331 12	18. 18. 18. 18. 18. 18. 18. 18. 18. 18.
Таха (сопппоп)	F drum Bluegid W basss	W bass	Sm bass	W bass	Sa Sas Sas Sas Sas Sas Sas Sas Sas Sas S	W bass	Bluegill	F drum	W bass Sm bass Farum	Smbass	F drum	orii Dass	W bass W bass	Sm bass	F drum	F drum	Sm bass Sm bass
O) qe7	O10FNZ OZZFNZ O33ENZ	045FN2	054FN2 8	065FN2	078FNZ 092FN2 02FN2	113FN2		137FN2		180FN2 S	192FN2		214FN2 224FN2 232FN2	246FN2 S		269FN2	280FNZ S 291FNZ S
Ol sussiT	Office OZZFN GGSFN	045FN	054FN	065FN	078FN 92FN 102FN	113FN	126FN	137FN	188 N	180FN	192FN	115U2	2, 2, 4. 2, 2, 4. 3, 4.	246FN	258FN	Z69FN	280FN :: 281FN
Field ID	010 022 033	045	2 8	990	23 23	113	126	137	149 770	98	192	3	2 2 2	246	258	569	82 182

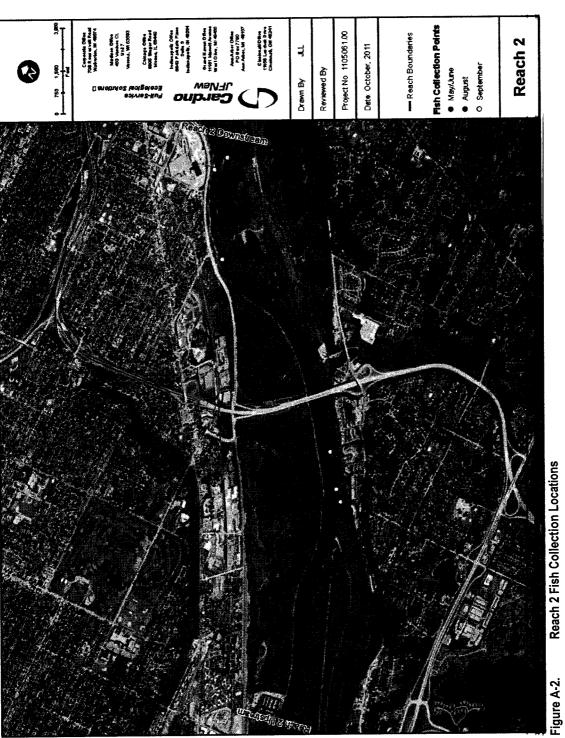
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Mississippi River Pool 2 PFC Assessment – Fish Tissues and Water – Summer 2011

Table A-2. AXYS Analysis of Fish Tissue Samples for PFCs (ND = RL)





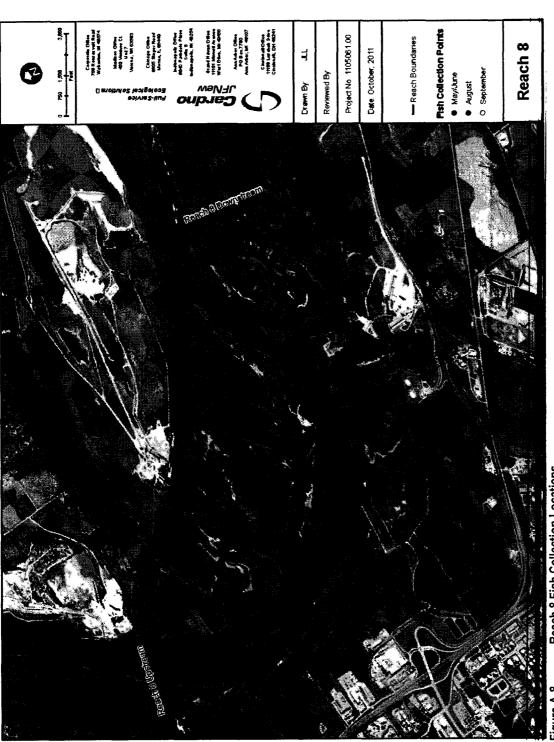
Reach 3 Fish Collection Locations Figure A-3.

Reach 4 Fish Collection Locations Figure A-4.

Reach 5 Fish Collection Locations



Reach 6 Fish Collection Locations Figure A-6.



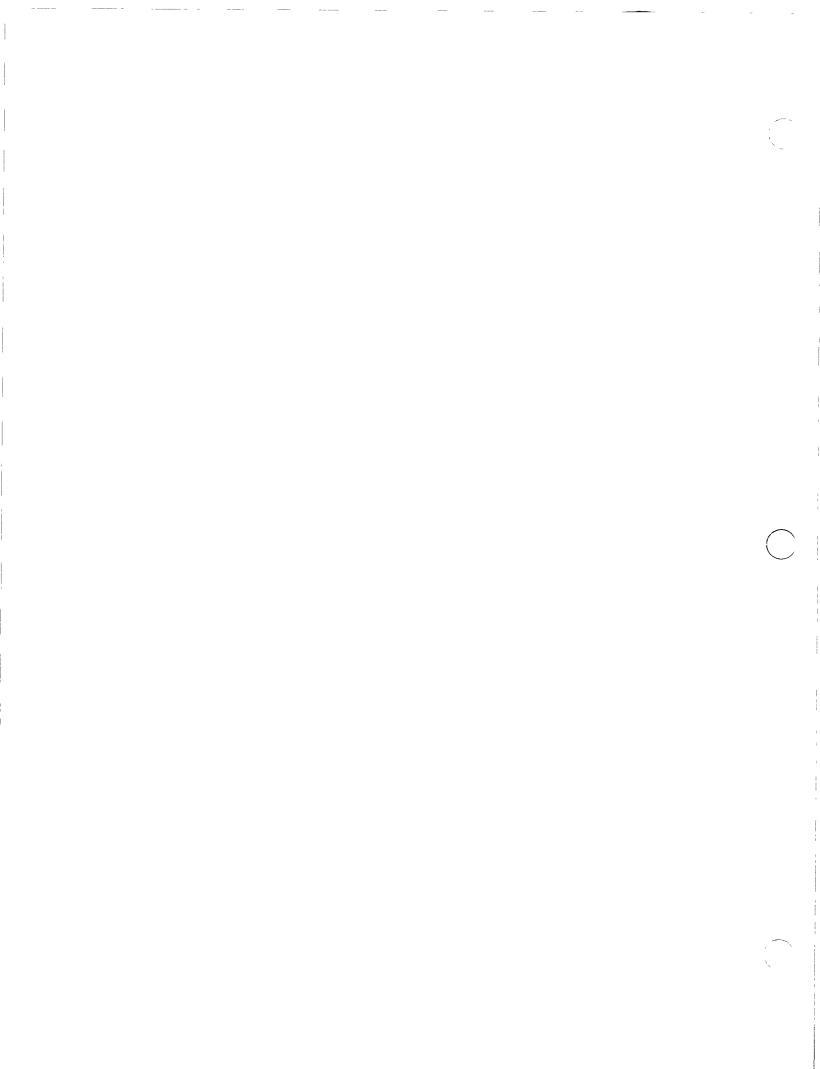
Reach 8 Fish Collection Locations

Reach 9 Fish Collection Locations Figure A-9.

Reach 10 Fish Collection Locations Figure A-10.

Appendix B

Water Sample Collection Tables & Figures



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November 2012

Appendix B Water Sample Collection

Tables **B**.1

Table B- 1. 3M Analysis of Water Samples for PFCs (ND = RL)

Aodaq	0 0 7 4.0 0 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	<4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 2.0	< 2.0	< 2.0	< 2.0	<20 <20
AnU39	0 0 V	0.45	< 4.0	< 4.0	< 4.0	<4.0	× 4.0	<4.0	< 4.0	< 4.0	< 4.0	<4.0	4.0	<20	< 2.0	< 2.0	< 2.0	<2.0 <2.0 <2.0
AG39	<25 <25	< 2.5	< 2.5	< 2.5	< 2.5	<2.5	<2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	<2.0	< 2.0	< 2.0	< 2.0	× 2.0 × 2.0
ANAG	<220 <20	520	< 2.0	< 2.0	< 2.0	< 2.0	20 20	< 2.0	< 2.0	< 2.0	< 2.0	<2.0	<2.0	<2.0	< 2.0	2.02	< 2.0	<20
AO49	137 2.39	< 2.0	4.56	2.53	2.81	2.25	2.24	2.06	2.15	< 2.0	< 2.0	< 2.0	2.23	6.12	3.96	219	3.59	2 - 55 2 - 65 2 - 65
AqH∃q	.5 <2.0	<2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	8.4	< 2.0	<2.0 <2.0
AxH∃d	12.9	< 2.5	< 2.5	< 2.0	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	2.96	< 2.0	31.7	< 2.0	< 2.0 < 2.0
A9444	16	< 4.0	< 4.0	< 4.0	< 4.0	0.4.5	<4.0	< 4.0	< 4.0	< 4.0	5.15	< 4.0	< 4.0	6.05	< 5.0	74.6	< 5.0	5.0 5.0 7.0
A879	92.4	9	9.14	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	18.6	19.5	648	14.7	7. 3
ASO79	:4.0	24.0	.4.0	2.0	: 4.0	< 4.0	ę	: 4,0	< 4.0	< 4.0	< 4.0	< 4.0	<4.0	: 2:0	: 2.0	: 5.0	2.0	< 2.0
PFOS	136 ***	4	2.0 <	2.0	2.0 <	< 2.0		< 2.0	< 2.0 <	< 2.0 <		< 2.0	< 2.0		_	136 <	15	2.0
PFHS	12.5		v	2.0 <	2.0 <	2.0	Y. 07:	< 2.0		2.0 <	2.0 <	2.0	2.0		< 2.0 <		< 2.0 2.	2.0 2
PFBS	26 11		2.0 <	2.5 <	2.0 <	< 2.0		< 2.0	< 2.0 < ;	< 2.0 <	< 2.0 <	< 2.0	Ť,	2.37	< 2.0 <	336 61	< 2.0 <	2.0 K
0030	73 27 27 4	21.12	18.	> ,66	85' <	× 107.	88	31' <	> '49	_	> ,69	43' <	1		521' <	13.	> '10	ू द
Start gnitesW	W92° 53.37 W92° 52.53	W93° 01.52	W93° 01.1′	W93° 00.99	W93° 06.08	W93° 05.24	W93°06.6	W93° 09.2:	W93° 09.06	W93° 07.907	W93° 11.48	W93° 11,4	W93° 10.274	W92° 52.3(W92° 52.52	W92° 53.3	W92° 56.5(W92* 57.50 W92* 58.10
		1		_										4.3			_	
Start BuinthoM	N44° 46.926 N44° 45.382	N44°47.47	N44° 47.086	N44° 46.447	N44° 56.048'	144° 56,589'	N44° 55.611	N44° 53.823	N44° 53.865'	N44° 54.699'	N44° 54.149'	N44° 54.001	N44° 53.636	N44° 46.018	N44° 45.382'	N44° 46.926	N44° 46.207	N44° 45.987 N44° 46.333
Кеасһ	10 h		8	∞	ح د	6	ر س	7	2	2	_			9	9	10	ے ص	<u>ි</u> ග ග
Cab ID	501SF1 502SF1	503SF1	504SF1	505SF1	506SF1	507SF1	508SF1	509SF1	510SF1	511SF1	512SF1	513SF1	514SF1	5153F1	516SF1	517SF1	518SF1	519SF1 520SF1
aı																		
Tissue Ol	1 501SF 2 502SF	1	1 504SF	5 505SF	3 506SF		7	9 509SF) 510SF	1 511SF	2 512SF	3 513SF	4 514SF	5 515SF	5 516SF	7 517SF	3 518SF	5/19SF 0 520SF
Gl bləi7	507 502	503	504	505	506	53	208	305	510	511	512	513	5 4	9	516	517	518	8 8 8 8 8

12

Novem

	0.7	0.2.0	0.2	7.7	O.X.	2.0	< 2.0	< 2.0	< 2.0	< 2.0	00	200	i c) c	0.5	2.0 - 2.0	2.0	< 2.0	20	2.0	< 2.0	< 2.0	< 2.0	20	2.0
		0.00	0.4 7	7.2.0	< 7.0 2.2.0			< 2.0	< 2.0 <	< 2.0 <		*		1			Olimbia.		< 2.0, <		< 2.0 <	< 2.0 <	2.0 <	2.0	<20 <:
i c) V V	2.0	0.5.0	7.5.0	< 2.0 2.0	2. V	< 2.0 - 2.0	< 2.0	< 2.0	< 2.0	N. (3)										•	2.0 <	2.0 <	2.0 <	2.0 - <
5	\ < 2.0	2.2.	2.2	, F.O.	/ 2.0 9.0) () (< 2.0	< 2.0	< 2.0	< 2.0	< 2.0							< 50 < 20 < 30 < 30 < 30 < 30 < 30 < 30 < 30 < 3			< 2.0 <	< 2.0 <	< 2.0 <	:2.0 ×	< 2.0
9/2	3 95	< 2.0	4.57	36.6		9		2.26	< 2.0	23.3	2.97			# #	2.51	3		<2.0			_	2.34	< 2.0		2.0
	< 2.0 < 2.0	< 2.0	< 2.0	- 0 C) () ()) k	< 2.0	< 2.0	< 2.0	< 2.0	270	< 2.0	< 2.0	< 2.0	2 6	> 2.0	v 2:0	0.2.0	< 2.0		< 2.0	< 2.0	L:	< 2.0
<20	2.15	< 2.0	< 2.0	- 00×		, 4.0 0.00	, k	0.2 >	< 2.0	3.29	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	000	7.2.0) , ,) , ,	, v.u.	0.2.0	< 2.0	< 2.0	< 2.0	< 2.0
6.02	< 5.0	< 5.0	< 5.0	< 5.0) V 5 5 7) ()))	0.0	0.0	< 5.0	0.5>	<5.0	< 5.0	< 5.0	< 5.0	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \)) ()		0.0	0.0	< 5.0	< 5.0	< 2:0
17.2	50	< 10.0	16.7	< 10.0	× 10 n	fe a		5.5	0.01 >	39.1	< 10.0	< 10.0	12.1	< 10.0	< 10.0	< 10.0	> 0		0.57	0.01	, , ,	0.0	< 10.0	E ;	777
< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	<2.0	000	< 2.0	0 0	0.0	< 2.0	\$2.0	< 2.0	<220	< 2.0	< 2.0	< 2.0	000	7 7 6 7		 	0.4.	0.0	< 2.0	0.2.0 0.5.0	2.7
2	3.51	< 2.0	2.77	< 2.0	< 2.0	2.6	<20	000) , r	1.1	< 2.0	> 2.0	< 2.0	< 2.0	< 2.0	2.0	< 2.0		200	< 20				< 20 · · ·	7
< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0) (< z.u	76	< 2.0				< 2.0 <	36	A pr	40		·		12	7	
< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	44	4. //	27 27 2	< 2.0	<2.0	< 2.0	< 2.0	< 2.0	14		< 2.0		•	200		, v.u.	
.886.00	01.130'	W93° 01.516'	W93° 00.424′	00.573'	00.740	30.576	0.620	0.927	101	101.10	1.896	7.7. 7 7	3.004	3.129	4.115'	5.248'	5.160	5.650	7,920	9.056′	3.236	, 279'			
W93°.00.988°	W93°	W93°	W93°	-W93°00.57	W93° 00,74	W93* 00.576	W93° 00.620'	W93° 00.927	W93° C	O COM	7.56/	W95° U2.547	0 - 584A	W93° 03.129	W93° 04.11	W93° 05.248'	W93° 0	W93° 06,650°	W93° 67 920	W93° 09.056′	W93° 09.236'	W93° 10 279	OLA AN OCUM	W93° 11 46°	
		N44° 47.463'	N44° 48.609′	N44° 49,305	N44° 50.012'	N44° 50,602'	N44° 51.126'	N44° 52.673'	N44° 53.478'	MAIN ES 7701	711.33	- 15 5 - 15	100.00 111	N44 56.082	N44° 56.830'	N44° 56.586'	V44° 56.006'	N44° 55.616°	N44° 54.672'	N44° 53.865'	N44° 53.827'	N44° 53.637'	NA4 82 0051	N44° 54,140'	
8 N44	8 N44	8 N44	7 N44	¥	夏	AN V	N44	N44,	N44	NAM				N44	N44°	N44°	<u>\4</u>	N44°	NA4°	N44°	N44°	N44°	· MAA	F ¥	
	522SF1 (2 L	0F7) (1)	SF1 6	SF1 6	SF1 6	SF1 5	77		i i		4	۲-1 4	F1 3	<u>Н</u>	F1 = 3	E C	F1 2	F1 2	F1 1	ĭ	- - -	tects
4 46				ď.	w.	F 527SF1	F 528SF1	F 529SF1	F 530SF1								537SF1	5 538SF1	539SF1	540SF1	541SF1	542SF1	543SF1		Bold, italicized text = Detects
				Ĺ			528SF	529SF	530SF			5338	I	2 10 10	10000	536SF	537SF	538SF	539SF	540SF	541SF	542SF	543SF	544SF	italicized
523	27.5	25.	470	CZ I	970	257	528	529	530	53	8	233	537	1 22		936 0	537	238	539	240	241	545	543	244 244	Bold,

Table B- 2. AXYS Analysis of Water Samples for PFCs (ND = RL)

Aodad	V V V	< 1.2	× 1.2 × 1.0	0 0 0	< 1.0	< 1.0	< 1.0	< 1.2	^ ^ \ 0	< 2.1	< 1.8	< 1.7	< 1.7	^ ^ 7:	< 1.6	< 1.9	< 1.8	& & .
Anuaq	^ ^ ^ ^ & 4 0	< 1.2	, , , 0:	2 2 C	< 1.0	< 1.0	< 1.0	< 1.2	0 1 V	< 2.1	< 1.8	<1.7	<1.7	^ <u>^</u>	< 1.6	< 1.9	× 1.8	
PFDA	2 × × × × × × × × × × × × × × × × × × ×	< 1.2	, , , , , , , , , , , , , , , , , , ,	6 5 5 5 5 5	< 1.0	< 1.0	< 1.0	< 1.2	0. K	< 2.1	< 1.8	< 1.7	<1.7	^ < 1.7 7.7 × 1.8	< 1.6	< 1.9	< 1.8	2 2 2 3 8 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
ANA	^ ^ ^ <u> </u>	< 1.2	, , , 0:	000	< 1.0	< 1.0	< 1.0	<1.2	< 1.0 < 1.7	<2.1	< 1.8	< 1.7	<1.7	7.1 > 7.1 > 8.1 >	< 1.6	< 1.9	< 1.8	^ ^ ^ ^ 2
AO49	7 × 1.4	2.2	5.77.01.0	A A Z	< 1.0	< 1.0	< 1.0	<1.2	<.1.0	2.7	2.0	2.5	3.3	< 1.7 < 1.8	3.23	< 1.9	< 1.8	× √ √ 2 2 ± 8 1 × 1 × 1 × 1 × 1 × 1 × 1 × 1 × 1 × 1 ×
AqH∃q	2.5 < 7.4 < 7.0 < 1.0	< 1.2	, , , , , , , , , , , , , , , , , , ,	v v 7	< 1.0	< 1.0	< 1.0	<1:2	< 1.0< 1.7	< 2.1	< 1.8	< 1.7	<1.7	< 1.7 < 1.8	1.9	< 1.9	< 1.8	2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 -
AxH4q	6.9 < 1.4 < 1.0	< 1.2	× × × × × × × × × × × × × × × × × × ×	0 0 0	< 1.0	< 1.0	< 1.0	< 1.2	<pre>< 1.0 </pre>	< 2.1	< 1.8	< 1.7	<1.7	< 1.7 < 1.8	< 1.6	< 1.9	< 1.8	2.6 <1.8 <2.1
A9474	6.4 <1.4	< 1.2	× 1.0 7.1.0	v v v	< 1.0	< 1.0	< 1.0	<1.2	\$ 10	< 2.1	< 1.8	< 1.7	<i>L</i> 1>	< 1.7	< 1.6	< 1.9	< 1.8	
A879	7 2 2	13	e.9 E.3	4 5 0	8.1	3.9	9.2	8.6	8.0	14	11	11	2.	F 2	11	11	9.9	* 3 P
ASO34	2 1 1 2 1 2 1 3 1 3 1 3 1 3 1 3 1 3 1 3	< 1.2	× 1.0 7.10	^ ^ ^ V	< 1.0	< 1.0	< 1.0	<1.2	<1.0 <1.7	<2.1	< 1.8	< 1.7	< 1.7	<1.7 <1.8 <1.8	< 1.6	× 1.9	× 1.8	7 2 8
PFOS	85 <27 <20	< 2.5	< 2.0 < 2.0	< 2.0 < 2.0 < 2.0	< 2.0	< 2.0	< 2.0	< 2.5	< 2.0 5.0	<4,1	< 3.7	< 3.5	4.94	<4.9 < 4.9	3.45	< 3.7	< 3.5	9.2 < 4.3 < 4.3
PFHS	6.3 < 2.7 < 2.0	< 2.4	< 2.0 < 2.0	< 2.0 < 2.0 < 2.0	< 2.0	< 2.0	< 2.0	< 2.5	<2.0 <3.4	<4.1	< 3.7	< 3.5	<3.3	< 3.4 < 3.6	< 3.3	< 3.7	< 3.5	<3.6 <4.3 <4.3
PFB\$	79 <2.7 2.3	2.9	< 2.0 < 2.0	< 2.0	< 2.0	5.6	< 2.0	< 2.5	< 2.0	<4.1	< 3.7	< 3.5	4.7	<3.4	< 3.3	< 3.7	< 3.5	6.8 <3.7 <4.3
Start gnitesW	W92° 53.313° W92° 52.521° W93° 01.521°	01.118'	06.085	W93° 05.240 W93° 06.663'	, 09.064	,02.907	W93° 11.459'	W93° 11.443'	W93° 10.274' W92° 52.305'	W92° 56.501'	W92° 57.531'	W92° 58.151'	W93° 00.424'	W93° 00.573° W93° 00.740°	W93° 00.576'	W93° 00.620'	W93° 00.927'	W93° 01.101' W93° 01.866' W93° 02.547'
F-13			_															
Start gnirthoM	N44° 46.926' N44° 45.382' N44° 47.471'	N44° 47.086'	N44° 56.048	N44° 56,589' N44° 55,611'	N44° 53.865	N44° 54.699	N44° 54.149'	N44° 54.001	N44°53.636' N44°46.018'	N44° 46.207	N44° 45.987	N44° 46.333'	N44° 48.609'	V44° 49,305′ V44° 50,012′	N44° 50.602	N44° 51.126'	N44° 52.673'	N44° 53.478' N44° 53.772' N44° 54.371'
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B.2

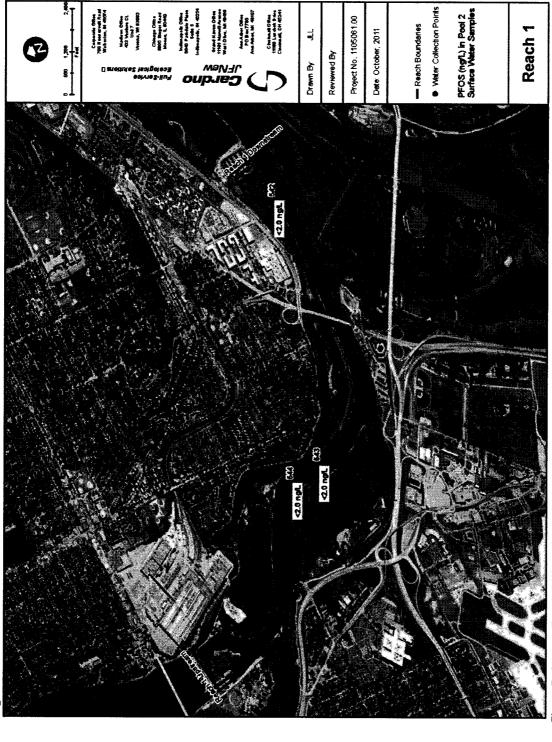
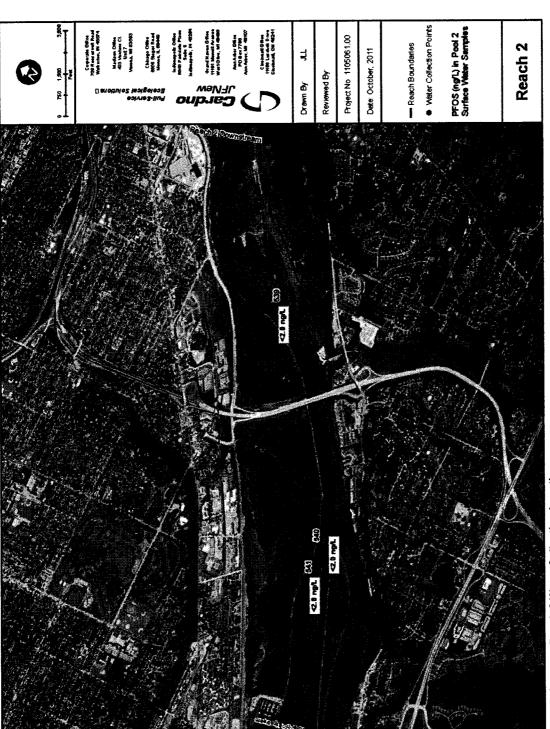


Figure B- 1. Reach 1 Water Collection Locations



Reach 2 Water Collection Locations Figure B-2.

Figure B-3. Reach 3 Water Collection Locations

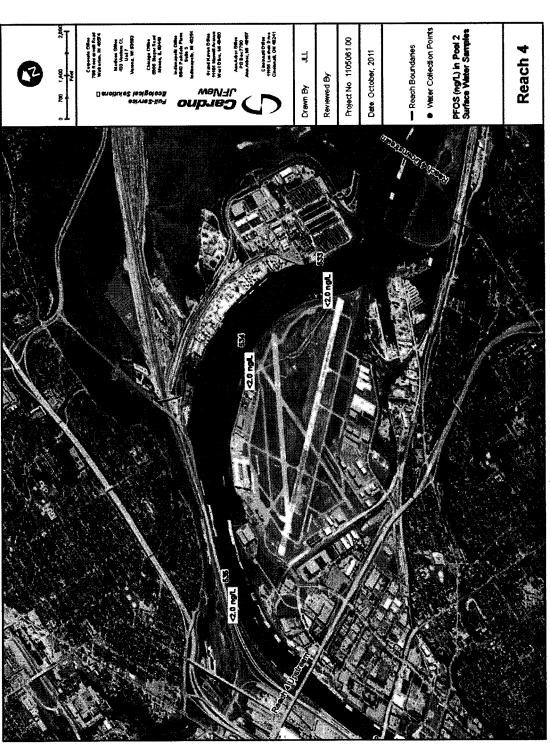


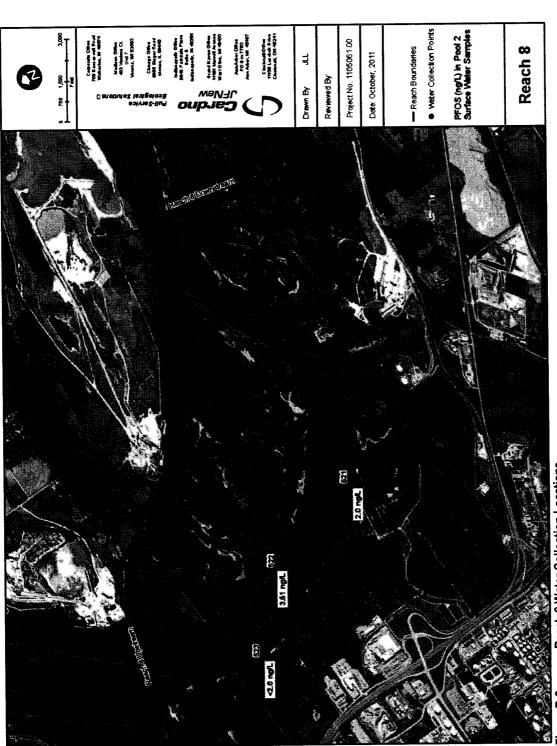
Figure B-4. Reach 4 Water Collection Locations

Reach 5 Water Collection Locations Figure B-5.



Reach 6 Water Collection Locations

Reach 7 Water Collection Locations



Reach 8 Water Collection Locations Figure B-8.

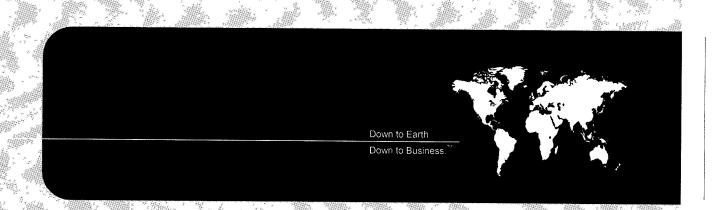
Reach 9 Water Collection Locations Figure B-9.

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Reach 10 Water Collection Locations Figure B-10.



Shaping the Future



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